COMPAQ

SMART-2DH Array Controller

Reference Guide

Second Edition (March 1998)
Part Number 295469-002
Compaq Computer Corporation

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About This Guide

This guide is designed to be used as a reference for operation, troubleshooting, and future upgrades.

Text Conventions

This document uses the following conventions to distinguish elements of text:

Keys	Keys appear in boldface. A plus sign (+) between two keys indicates that they should be pressed simultaneously.
USER INPUT	User input appears in a different typeface and in uppercase.
FILENAMES	File names appear in uppercase italics.
Menu Options, Command Names, Dialog Box Names	These appear in initial capital letters.
COMMANDS, DIRECTORY NAMES, and DRIVE NAMES	These always appear in uppercase.
Type	When you are instructed *to type* information, type the information **without** pressing the **Enter** key.
Enter	When you are instructed *to enter* information, type the information and then press the **Enter** key.

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Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.

WARNING: Indicates that failure to follow directions in the warning could result in bodily harm or loss of life.

CAUTION: Indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Presents clarifying information or specific instructions.

NOTE: Presents commentary, sidelights, or interesting points of information.

Symbols on Equipment

These icons may be located on equipment in areas where hazardous conditions may exist.

Any surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.
WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.

Any RJ-45 receptacle marked with these symbols indicates a Network Interface Connection.
WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

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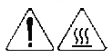

Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Power Supplies or Systems marked with these symbols indicate the equipment is supplied by multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the system.

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Web Site

The Compaq Web Site has information on this product as well as the latest drivers and Flash ROM images. You can access the Compaq Web Site by logging on to the Internet at http://www.compaq.com.

Telephone Numbers

For the name of your nearest Compaq Authorized Reseller:

In the United States, call 1-800-345-1518
In Canada, call 1-800-263-5868

For Compaq technical support:
In the United States and Canada, call 1-800-386-2172
For Compaq technical support phone numbers outside the United States and Canada, visit the Compaq Web Site at http://www.compaq.com.

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Chapter 1
Features

The Compaq SMART-2DH Array Controller is a dual-channel, 32-bit array controller with many advanced features. The controller supports all SCSI hard drives: Wide-Ultra SCSI, Fast-Wide SCSI-2, and Fast-SCSI-2. Included with the SMART-2DH Array Controller is the Compaq Array Configuration Utility, which provides easy drive array setup and configuration changes.

Overview of Features

Listed below are some of the features of the SMART-2DH Array Controller option board:

- Support for RAID 0, 1, 4, and 5 fault tolerance options
- Online capacity expansion
- Supports Wide-Ultra SCSI; a 16-bit, 20-MHz bus providing a 40-Mbytes/sec data transfer rate
- Support for Wide-Ultra SCSI, Fast-Wide SCSI-2, and Fast-SCSI-2 hard drives
- Dual channels on a single board to support up to 14 drives (7 per channel)
- Wide-Ultra SCSI/Fast-SCSI-2 (Wide SCSI) internal connector
- Wide-Ultra SCSI/Fast-SCSI-2 (Wide SCSI) external connector
- Removable Array Accelerator - battery-backed 16-MB Read/Write Cache with ECC (Error Checking and Correcting) memory
- Performance monitoring through Compaq Insight Manager
- Automatic performance tuning
- Pre-failure notification
- Read-ahead caching
- Tagged command queuing
- Multiple logical drives per drive array
- Support for drive and array movement
- Available in 32-bit PCI Bus Master interface

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SMART-2DH Array Controller

The SMART-2DH Array Controller interface to the server is a Peripheral Component Interface (PCI) bus. The PCI bus is a high-performance, 32-bit bus with multiplexed address and data lines, and includes a parity signal. It provides a high-speed (up to 132 Megabytes/sec) path between the system board and the SMART-2DH Array Controller.

The SMART-2DH Array Controller is a PCI Bus Master device and conforms to Rev. 2.0 or greater of the PCI Local Bus Specification.

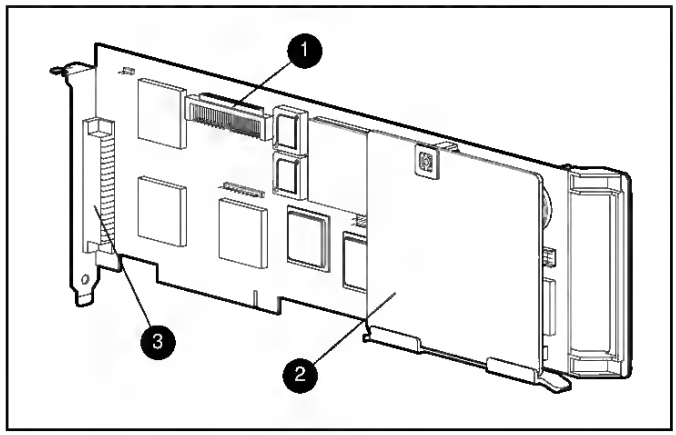

Figure 1-1. **SMART-2DH Array Controller**

Major components of the SMART-2DH Array Controller include:

❶ Internal Wide-Ultra SCSI Port 1 connector

❷ Array Accelerator board

❸ External Wide-Ultra SCSI Port 2 connector

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Drive Arrays

Drive array technology distributes data across a series of hard drives to unite these physical drives into one or more higher performance *logical drives*. Distributing the data makes it possible to access data concurrently from multiple drives in the array, yielding I/O rates faster than non-arrayed drives. Each logical drive in the array may be set to a different fault tolerant configuration. The SMART-2DH Array Controller manages the drive array independent of the host processor.

There may be several possible ways to configure each set of hardware. The Array Configuration Utility is used to help you configure the hardware in the way that best suits your needs.

CAUTION: It is recommended that any time you move drive arrays or change your configuration you should back up data.

See Appendix D for more information on drive arrays. See Chapter 5, "Running the Array Configuration Utility," for information on configuring your drive arrays using the Compaq Array Configuration Utility.

Fault Tolerance

Fault tolerance refers to several possible methods used to protect data from being lost in the event of a hardware failure somewhere in the storage system. Each method has its advantages, so choosing one requires careful planning for your particular requirements.

The fault tolerance methods supported by the SMART-2DH Array Controller and the Compaq Array Configuration Utility include:

- Distributed data guarding (RAID 5)
- Data guarding (RAID 4)
- Drive mirroring (RAID 1)
- No fault tolerance (RAID 0)

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Further data protection can be achieved by assigning an online spare to any RAID 1, RAID 4, or RAID 5 configuration. See Appendix D for more information on these fault-tolerance methods. See Chapter 5 for information on configuring your system for one of the fault tolerance methods.

Capacity Expansion

Capacity Expansion refers to the ability to change an existing data storage configuration. This change usually involves adding drives to provide more storage space.

Using the Array Configuration Utility, changing your storage configuration is easy, even in fault-tolerant configurations, without requiring a data backup and restore cycle. If you are using Microsoft Windows NT or Novell NetWare operating systems with hot-pluggable drives, storage expansion can also be performed online, without shutting down the server operating system. For more information on storage expansion, see Appendix D, "Understanding Drive Arrays."

Drive Movement

An array of drives can be moved from one system to another as long as the relative order of the drives is maintained. For more information, see Chapter 2.

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Wide-Ultra SCSI, Fast-Wide SCSI-2, and Fast-SCSI-2

The SMART-2DH Array Controller complies with ANSI SCSI-2 standards, supporting 16-bit Wide-Ultra SCSI, 16-bit Fast-Wide SCSI-2, and 8-bit Fast-SCSI-2 (standard SCSI) devices.

Wide-Ultra SCSI

Wide-Ultra SCSI technology provides SCSI data transfer rates of up to 40-Mbytes/sec at a 20-MHz bus rate. This combination allows high throughput in many network application environments, including resource sharing and database servicing.

Fast-Wide SCSI-2 and Fast-SCSI-2

Fast-Wide SCSI-2 provides two bytes of data at each bus transfer, providing a maximum of 20-Mbytes/sec data rate between SCSI devices while still maintaining a 10-MHz bus rate.

Compaq Fast-Wide SCSI-2 controllers and devices are able to communicate using Fast-SCSI-2 protocol when required. Therefore, Fast-SCSI-2 drives may also be used with SMART-2DH Array Controller using the appropriate cable adapter.

Array Accelerator

The SMART-2DH Controller Array Accelerator provides a 16-MB onboard write cache. The result is improved performance on data access to the drive array by serving as a posted-write cache and read-ahead cache. The write cache can accept data from the server at 60 megabytes per second. At the same time, read and writes caches can be accommodated by the drivers. The read-ahead cache uses a multi-threaded algorithm to predict the next likely read operation for the array. That data is then read into the Array Accelerator from the drives. When the SMART-2DH Array Controller receives a read request for the cached data, it can be brought immediately into system memory bus speeds. The Array Accelerator feature may be disabled by software if desired.

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NOTE: The SMART-2DH Controller Array Accelerator is equipped with a switch that may be activated to fine tune system performance. See Appendix E for further information.

The Array Accelerator is made of ECC (Error Checking and Correcting) memory, providing a high level of data integrity. ECC memory detects and corrects hard and soft memory errors without affecting performance.

The Array Accelerator is backed up with onboard rechargeable batteries, ensuring that the data temporarily held (cached) there is safe even with equipment failure or power outage. This is particularly important for data that has been cached by a posted-write, but has not yet been written to the hard drives. The batteries preserve data in the Array Accelerator for up to four days.

IMPORTANT: The rechargeable batteries on a new SMART-2DH Array Controller may be discharged when the board is first installed. During server power up with discharged Array Accelerator batteries, Power-On Self-Test (POST) displays the code "1794," indicating that the Array Accelerator is disabled. This is not a problem that requires action on your part. The Array Accelerator is automatically enabled when the batteries are charged to 90% of their capacity.

It may take up to 36 hours for the internal circuitry to charge the batteries fully. During this time, the Array Accelerator will be disabled, but the SMART-2DH Array Controller will function properly, although without the performance advantage of the Array Accelerator.

The Array Accelerator, with backup batteries, is located on a removable daughter board. In the unlikely event of failure, the Array Accelerator can be detached from the failed SMART-2DH Array Controller and attached to a replacement SMART-2DH Array Controller. If the configuration information stored in the Array Accelerator matches that stored on the drives, any valid posted-write data being held in the cache is automatically written to the drives attached to the replacement Array controller. Thus, data being held in the Array Accelerator memory can be recovered despite failure of the main SMART-2DH Array Controller board.

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Array Configuration Utility Features

The Compaq Array Configuration Utility is an easy-to-use graphical configuration utility to help you set up and change drive array configurations. This utility:

- Provides a graphical view of Compaq drive array configurations
- Provides express or custom initial configuration
- Supports easy capacity expansion
- Supports RAID 0, 1, 4, and 5 fault-tolerant configurations
- Helps optimize your array configuration with configuration Wizards
- Sets drive rebuild and capacity expansion priorities
- Allows online spare (hot spare) configuration
- Allows separate fault tolerance configuration on a logical drive basis

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Chapter 2
Guidelines for Making Changes to Current Installation

Multiple SMART-2DH Controller Installation

When you install more than one SMART-2DH Array Controller in the same server, the following considerations apply:

- Each SMART-2DH Controller has two independent SCSI channels, each of which supports up to seven drives.
- Each SCSI channel has its own set of unique SCSI IDs (from 0 to 6). You must assign each peripheral on the bus a unique ID for that bus.

Since only one of the two SCSI ports is available on its external connector, the other internal port must be brought out to an external connector if it is to be used for external storage. In some servers, a connector panel is provided for this purpose, but in others the internal port is brought out through an unused option slot using a special connector bracket.

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Drive Considerations

If you will be installing or replacing drives in your Compaq server, keep in mind that:

- Drives may be Fast-SCSI-2, Fast-Wide SCSI-2, Wide-Ultra SCSI, or a mixture of the three in servers and storage systems supporting hot-pluggable drives.
- Drives should *not* contain termination. Compaq servers and internal cabling provide the required termination of the SCSI bus.
- Compaq hard drives supported by the SMART-2DH Controller include:

  1.05-GB Fast-SCSI-2
  2.1-GB Fast-SCSI-2
  2.1-GB Fast-Wide SCSI-2
  2.1-GB Wide-Ultra SCSI
  4.3-GB Fast-SCSI-2
  4.3-GB Fast-Wide SCSI-2
  4.3-GB Wide-Ultra SCSI
  9.1-GB Wide-Ultra SCSI
  9.1-GB Fast-SCSI-2
  18.2-GB Wide-Ultra SCSI 3

- Drives should be of the same capacity to provide the greatest storage space efficiency when grouped together into the same drive array.
- Except on hot-plug drives in ProLiant servers and storage systems, you must manually set the SCSI ID on each drive to a unique value in the range of 0 to 6 for each SCSI bus. Consult the documentation that came with the drive for instructions on setting the SCSI ID.

Determining the Maximum Storage

Maximum storage capacity factors of a server include:

- subtract any option slots used for other purposes
- available internal drive bays
- availability of external connectors for SCSI Bus 1 (requires connector panel location or vacant option slot)

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- some operating systems limit number of logical drives or drive controllers

The maximum number of controllers and drives supported depends on several factors. To determine the number of drives supported by your server, refer to the Setup and Installation Guide, or Reference Guide, that accompanied your server. Server specifications are also available at our website, www.compaq.com.

Expanding the Capacity of an Array

Below is an overview of procedures for expanding the capacity of an array.

1. **Review**. See Appendix D, "Adding Storage Capacity," for information on expanding the storage capacity of an existing SMART-2DH array.
2. **Back up data**. Although data loss is not anticipated during a normal capacity expansion, it is a good idea to back up all data in the array you will be expanding. This backup may also be used to return to the original configuration, if necessary.
3. **Add drives**. If you are using a server or storage system that *does not* support hot-pluggable drives, you will need to power down the server or storage system to add new drives. If you are using a server or storage system that *does* support hot-pluggable drives, do not power down the system or take it offline. Simply plug the new drives into vacant bays.
4. **Configure drive array**. See "Capacity Expansion" in Chapter 5 for instructions on using the Compaq Array Configuration Utility to reconfigure your drive array to make use of the added capacity. If your operating system supports it, run the Array Configuration Utility online to guide you through the process. The controller automatically redistributes the data.

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Changing the Fault Tolerance

An overview of the procedures to change the fault tolerance is provided below.

1. **Decide on a fault-tolerance method**. Review Appendix D, "Understanding Drive Arrays," and choose the fault-tolerance method that best suits your needs.
2. **Back up data**. Changing the fault tolerance will destroy the data on that logical drive. You **must** back up all data in the logical drive that you will be changing.
3. **Configure drive array**. Proceed to Chapter 5, "Running the Array Configuration Utility," for information on reconfiguring your drive array with the new fault-tolerance method.
4. **Restore data**. Copy the backed-up data into the same logical drive. Your system automatically redistributes the data according to the new fault-tolerance method.

Moving Drives

Drives can be moved to alternate ID positions on the same array controller as long as their relative positions remain unchanged. (For information on moving arrays from one controller to another, see the section in this chapter, "Moving Arrays.") Although data loss is not anticipated during drive movement, it is recommended you back up data before moving drives. To move drives, the following conditions must be met:

- Controller firmware is the latest revision (currently 2.02).
- System power is OFF (includes all system components).
- The move will not result in more than 7 physical drives and/or 32 logical drives (volumes) connected to a single controller.
- No failed drives identified. The array should be in its original configuration with no active spare drives.
- Capacity expansion is not running.
- Drives in each array must maintain same the same relative positions before and after drive movement as shown in Figure 2-1.

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The original configuration in Figure 2-1 shows drive positions 0, 3, and 6 filled. The drives are moved to positions 0, 1, and 2. In both configurations, the relative order of the drives stays the same: a, then b, then c. This example would not work if the new configuration changed the relative orders of the drives, that is, b, then a, then c. The new positions can also span multiple buses as long as the relative order remains the same; in this case, think of drive IDs 0 and 1 on SCSI port 2 as IDs (positions) 7 and 8. SCSI cables cannot be interchanged if an array spans the two ports.

Original Configuration		→	New Configuration	
ID6	c		ID6	
ID5			ID5	
ID4			ID4	
ID3	b		ID3	
ID2			ID2	c
ID1			ID1	b
ID0	a		ID0	a

Figure 2-1. **Maintaining relative drive order while moving drives within or between arrays**

When the above conditions are met, follow these steps to move drives:

1. Power system OFF.
2. Move drives.
3. Power system ON. A 1724 POST message should indicate that drive positions were changed and the configuration was updated. If the system comes up with a 1785 (Not Configured) POST message, turn the system off immediately to avoid data loss and return the drives to their original locations.
4. Run Array Configuration Utility to view the new drive configuration (optional).

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Moving Arrays

Moving arrays refers to consolidating arrays that exist on more than one controller onto a single controller. To move an array to another controller, the conditions listed previously for moving drives, and the following additional restrictions must be met:

- All of the drives in the array must be moved at the same time.
- Positions of drives on the destination controller should not be moved at the same time.

If any drives are missing or have failed, all data on the moved arrays could be lost. To protect against data loss, data should be backed up before moving an array. If you have previously moved an array and plan to restore it to its original controller, see the following section, "Restoring an Array to Its Original Controller."

Figure 2-2 shows an original distributed configuration with two controllers, each having one array: drive IDs 0, 1, 2, and 3 constitute Array A on Controller 1 and drive IDs 0, 1, and 2 constitute Array A on Controller 2. Figure 2-3 shows that after removing the array from Controller 2 and adding it to Controller 1, Controller 1 has two arrays: drive IDs 0, 1, 2, and 3 constitute Array A and drive IDs 4, 5, and 6 constitute Array B. Controller 2 has no arrays.

NOTE: A spare can be added as part of an array during this process. However, it will not be restored as a spare until you run Array Configuration Utility on the newly configured array.

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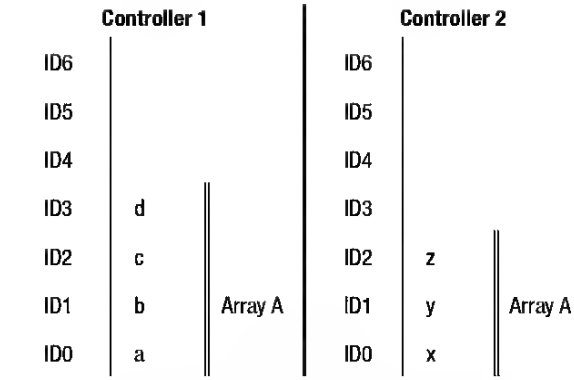

Figure 2-2. **Configuration with two arrays, two controllers**

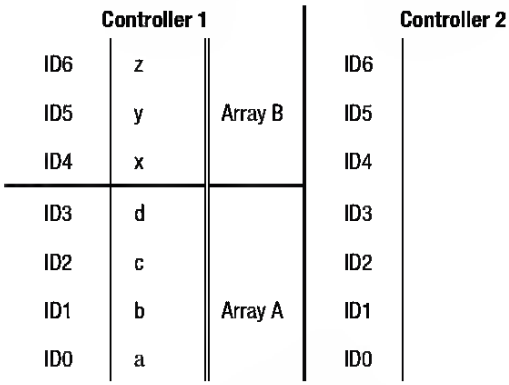

Figure 2-3. **Arrays consolidated to one controller**

To move an array, make sure all required conditions are satisfied, then:

1. Power system OFF.
2. Move array (include all drives in the array).

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3. Power system ON. A 1727 POST message should indicate that logical drives were added to the configuration. If the system comes up with a 1785 (Not Configured) POST message, turn the system off immediately to avoid data loss and return the drives to their original locations.

   NOTE: If you move arrays from a dual-channel controller to a single-channel controller, you may get an error message indicating a configuration error. If you get this error message:

   - Return to the previous dual-channel controller configuration.
   - Back up data on the array.
   - Move the drives to the single-channel controller.
   - Run Array Configuration Utility on the single-channel controller to configure the array.
   - Restore data to the array.

4. Run Array Configuration Utility to view the new drive configuration or to assign spare drives (optional).

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Restoring an Array to Its Original Controller

If you have moved an array from one controller to another, you can restore it to its original controller. Figures 2-4 through 2-6 show the consecutive configurations required to restore an array to its original controller (or to a replaced controller in the event of controller failure). Figure 2-4 shows the consolidated configuration that includes Array A with drive IDs 0 through 3 and Array B with drive IDs 4, 5, and 6. Moving Array B back to Controller 2 creates an interim four-array state, with Array B on Controller 1 and Array A on Controller 2 appearing as failed. Running Array Configuration Utility removes the "failed" arrays and restores the original two-array configuration.

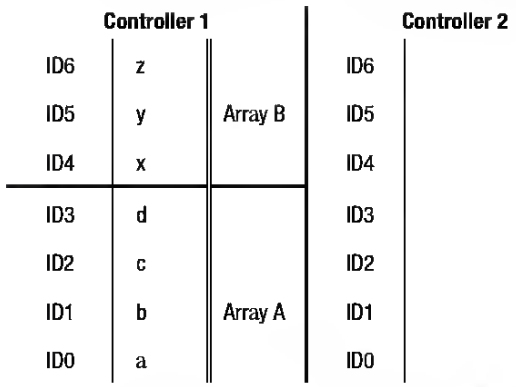

Figure 2-4. **Arrays A and B both attached to Controller 1**

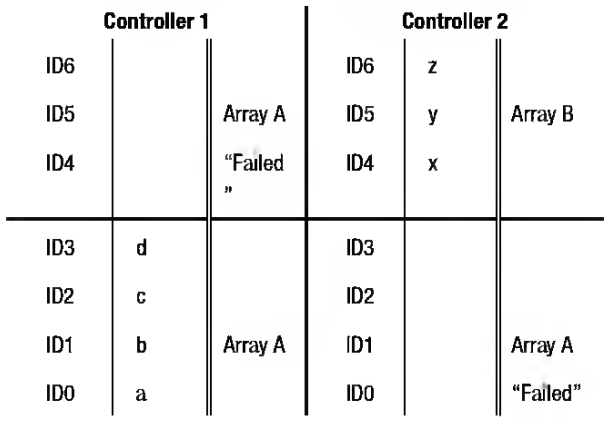

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Figure 2-5. **Interim four-array state**

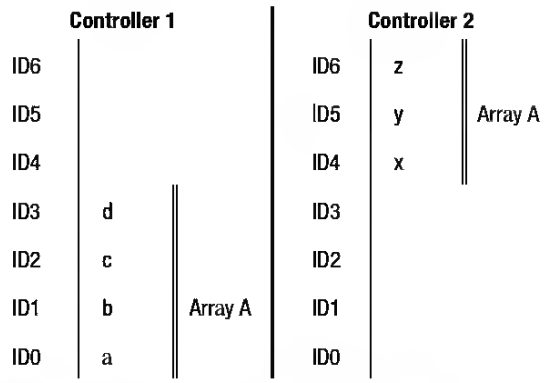

Figure 2-6. **Failed arrays removed; arrays on separate controllers**

To restore an array to its original controller, make sure the conditions for moving drives are met. Then:

IMPORTANT: These steps must be followed EXACTLY. Any deviation or mistake could result in the loss of all data across all moved arrays.

1. Power system OFF.
2. Move the array back to its original controller, but retain its drive position as it was in the consolidated configuration.
3. Power system ON.
4. Each controller will indicate a 1789 POST message that drives are missing. Press **F2** to fail the missing drives.
5. Run Array Configuration Utility and remove the appropriate "failed" arrays.
6. Reboot the system.

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Chapter 3
Updating the Firmware

The ROMs on all Compaq servers and most Compaq options can be updated easily. This is done by *flashing* the ROM using a special Compaq utility called ROMPaq, which replaces the existing contents of the ROM with another version stored in a disk file. This is a convenient way to distribute new firmware to keep Compaq products updated with the latest capabilities.

There are two ROMPaq utilities:

System ROMPaq for updating the system ROM in all Compaq servers supporting Flash ROM. Use System ROMPaq when installing a new SMART-2DH Controller in a Compaq server to be sure that the server can utilize all the capabilities of the SMART-2DH Array Controller.

Option ROMPaq for updating the onboard ROM on all Compaq options that support flashing. Use Option ROMPaq when new versions of the SMART-2DH Array Controller firmware or SCSI drive firmware become available to take advantage of expanded capabilities.

IMPORTANT: Before you install the new SMART-2DH Array Controller in your server, you must run System ROMPaq to update the system firmware. Use the instructions below to create diskettes with the latest version of System ROMPaq from the Compaq SmartStart and Support Software CD supplied with the SMART-2DH Controller.

ROMPaq Diskettes

The ROMPaq utilities must be run from diskette(s). The latest version of the ROMPaq diskettes may be created from the Compaq SmartStart and Support Software CD that was supplied in the SMART-2DH Controller Option Kit. We recommend that you initially use this version of ROMPaq because it is the latest one that supports your new SMART-2DH Controller.

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Materials Needed

You will need the following items to create ROMPaq utility diskette(s):

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Array Controller Option Kit)
- One blank diskette (for System ROMPaq) or three or four blank diskettes (for Option ROMPaq), depending upon your server
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating Diskettes

To create ROMPaq diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, scroll down the list and select one of the following three ROMPaq selections: System ROMPaq Firmware Upgrade Diskette for Compaq ProLiant Servers, System ROMPaq Firmware Upgrade Diskette for Compaq Systempro/XL and Compaq ProSignia Servers, or Option ROMPaq.
4. Follow the instructions on the screen to create the ROMPaq diskette(s).

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Running System ROMPaq

System ROMPaq is used to update the firmware in Compaq servers. The SMART-2DH Controller has enhanced drive array capabilities; many existing servers may not be able to take advantage of these capabilities without updated firmware. Since it is difficult to determine when the firmware needs to be updated, Compaq recommends that you run the latest System ROMPaq on all servers when installing a new SMART-2DH Controller. If you purchased your server with the SMART-2DH Controller already installed, you do not need to run System ROMPaq at the time of server installation.

CAUTION: If you are replacing an existing array controller, such as the Compaq SMART Array Controller, with the SMART-2DH Controller, the system may not boot after hardware installation. It may not boot if the old array controller was the primary controller containing the boot disk.

To avoid this problem when replacing an existing array controller with a SMART-2DH Controller you should run System ROMPaq before you make the hardware installation. This will ensure that the server will recognize the SMART-2DH Controller and not hang up on boot.

To run System ROMPaq:

1. Place the System ROMPaq diskette in the server diskette drive.
2. Boot the server by turning on the power.
3. Press **Enter** at the Welcome screen.
4. At the Select A Device screen, select the server from the list of the programmable devices. This may be the only item in the list. Press **Enter**.
5. At the Select An Image screen you will see:

Device to reprogram:	*your server*
Current RDM revision:	*date of existing ROM version*
Select Firmware Images:	*date of latest ROM version*

Press **Enter**.

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6. Review the information on the Caution screen:

Device to reprogram:	*your server*
Current ROM revision:	*date of existing ROM version*
Selected ROM revision:	*date of ROM version to be installed*

Press **Enter** to reprogram the system ROM or **Esc** to discontinue reprogramming and return to the Select An Image screen.

7. "Reprogramming Firmware" indicates that the system ROM is being reprogrammed. DO NOT INTERRUPT.

IMPORTANT: Do not interrupt this cycle. Interrupting the ROM reprogramming will leave the firmware in an unknown state. You may not be able to boot the server if this happens. You will be notified that reprogramming is completed.

8. When ROMPaq is finished reprogramming the system ROM, press **Esc** to exit the System ROMPaq Utility.
9. Remove the System ROMPaq diskette and reboot the server by cycling the power (cold boot).

If you have not yet installed your new SMART-2DH Controller, you may do so at this time.

Running Option ROMPaq

Option ROMPaq is used to update the firmware on Compaq options. Use Option ROMPaq to update the capabilities of the SMART-2DH Controller and drives whenever an updated version is available in the future. Since it is difficult to determine when to update the firmware, Compaq recommends that you run the latest Option ROMPaq on all SMART-2DH Controllers whenever it becomes available.

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The latest version of firmware for the SMART-2DH Controller firmware has already been installed. If you have older SMART-2DH Controllers or other Compaq options, such as drives, create the Option ROMPaq diskettes and check that the firmware on these options is at the latest revision.

To run Option ROMPaq:

1. Place the Option ROMPaq diskette 1 in the server floppy drive.
2. Boot the server by turning on the power.
3. Press **Enter** at the Welcome screen.
4. At the Select A Device screen, select:
   ALL COMPAQ SMART-2OH Controller(s)
   from the list of programmable devices. Press **Enter**.
5. If the ROM firmware in the SMART-2DH Controller is the same or newer than that on the Option ROMPaq diskette, you will get the message:

   ```
   The ROM image files found for the device selected
   are not newer than the current ROM image
   ```

   Press **Enter** to go to step 9.
   OR
   If the ROM firmware in the SMART-2DH Controller is older than that on the Option ROMPaq diskette, you will get the Select An Image screen:

   ```
   Oevice to reprogram:     ALL COMPAQ SMART-2OH Controller(s)
   Current ROM revision:    COMPAQ SMART-2OH Controller x.xx
   Select Firmware Images   COMPAQ SMART-2DH Controller y.yy
   ```

   Press **Enter**.

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6. Review the information on the Caution screen:

Device to reprogram:	ALL COMPAQ SMART-2DH Controller(s)
Current ROM revision:	COMPAQ SMART-2DH Controller x.xx
Selected ROM revision:	COMPAQ SMART-2DH Controller y.yy

Press **Enter** to reprogram the SMART-2DH Controller ROM or **Esc** to discontinue the reprogramming and return to the Select An Image screen.

7.

Reprogramming Firmware

indicates that the SMART-2DH Controller ROM is being reprogrammed. DO NOT INTERRUPT.

CAUTION: Do not interrupt this cycle. Interrupting the ROM reprogramming will leave the firmware in an unknown state. If this happens you may not be able to reprogram the ROM and the SMART-2DH Controller ROM may have to be replaced. You will be notified that reprogramming is completed.

8. When Option ROMPaq is finished reprogramming the SMART-2DH Controller ROM, press **Enter** if you wish to reprogram another Compaq option. Repeat steps 4 - 7.
9. If you are finished with reprogramming options, press **Esc** to exit the ROMPaq Utility.
10. Remove the Option ROMPaq diskette and reboot the server by cycling the power (cold boot). To upgrade additional options in the server, repeat steps 2 - 9 by booting from each Option ROMPaq diskette in succession.

The SMART-2DH Controller ROM has been updated; you can take advantage of the new or increased capabilities, if any, available with the new firmware.

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Chapter 4
Running the System Configuration Utility

The Compaq System Configuration Utility is used to configure the hardware installed in or connected to the server easily. This utility allows the server to know how each piece of hardware should be handled when communicating with it.

The System Configuration Utility performs a wide range of configuration activities, including the following:

- Configures PCI boards automatically
- Provides switch and jumper settings
- Resolves resource conflicts in areas such as memory, port addresses, and interrupts (IRQs)
- Manages the installation of memory, processor upgrades, and mass storage devices such as hard drives, tape drives, and diskette drives
- Sets and stores power-on features like date and time
- Stores configuration information in nonvolatile memory
- Assists in the installation of the operating system
- Assists in running diagnostic tools such as TEST and INSPECT

System Configuration Utility

The Compaq System Configuration Utility can be run directly from the Compaq SmartStart and Support Software CD supplied with the SMART-2DH Array Controller Option Kit and the Compaq server. You may already have a version of this utility in the system partition of the boot disk; however, you will need Compaq SmartStart and Support Software CD version 3.40 or later. Compaq recommends that you use the version of the utility supplied on the CD because it is the latest one that supports the SMART-2DH Controller.

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If your server does not have a bootable CD-ROM drive, you can create diskettes of the latest version of the System Configuration Utility from the Compaq SmartStart and Support Software CD. See the following section, "System Configuration Diskettes," for instructions on creating these diskettes.

If your server has a bootable CD-ROM drive, proceed to "Running the System Configuration Utility."

System Configuration Diskettes

The latest version of the Compaq System Configuration Utility can be created from the Compaq SmartStart and Support Software CD that was supplied in the SMART-2DH Controller Option Kit.

Materials Needed

You will need the following items to create Compaq System Configuration Utility diskettes:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Controller Option Kit)
- At least four blank diskettes
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating Diskettes

To create System Configuration Utility diskettes:

1. Boot the computer from the Compaq SmartStart and Support Software CD.
2. From the main menu screen, select Create Support Software.
3. Scroll down the list and select Compaq System Configuration Utility.
4. Follow the instructions on the screen to create the utility diskette(s).

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Running the System Configuration Utility

To run the System Configuration Utility:

1. Place the Compaq SmartStart and Support Software CD in the server CD-ROM drive.
   or
   Place the System Configuration Utility diskette 1 in the server floppy drive.
2. Reboot the server.
3. During the boot process, several messages are displayed. Among these will be a notice that one or more SMART-2DH Controllers were detected in option slots, and a recommendation to run the System Configuration Utility.
4. If prompted, press **F1** to resume booting.
5. If you are using the Compaq SmartStart and Support Software CD, select Run the System Configuration Utility from the main menu screen.
6. If you are given a choice of Auto Configuration, choose Yes.
7. The system loads configuration files for all detected devices.
8. In the Configuration Complete screen, be sure to choose Review or modify hardware settings.
9. From the next screen, Steps In Configuring Your Computer, select Step 3: View or edit details.
10. The View Or Edit Details screen is where you will set the SMART-2DH Controller(s) configuration parameters. Scroll down to the option slot for the first SMART-2DH Controller and edit each parameter according to the following information.

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Configuring the Controller

1. Edit these parameters for SMART-2DH Controller:

   Controller Order

   Under Advanced Features:

   Online Recovery Server Status

   PCI Memory Overlay Setting

   Press **Enter** to select the parameter to edit.

   To help you make the correct selections, explanations of these parameters are included below.

   Controller Order
   Select the order in which you want this SMART-2DH Controller to be recognized. All hard disk controllers, including the integrated controller on the system board, must be assigned a unique order number.

   First The primary disk controller that contains the boot disk. The first disk drive on this controller is the one that the server will boot from.

   Second The second disk controller.

   .
   .

   Fifteenth The fifteenth disk controller.

   When installing a SMART-2DH Controller, you must determine if the boot disk is to be handled by a SMART-2DH Controller or the integrated SCSI controller. If this SMART-2DH Controller will be the primary controller, choose First; a Configuration Changes screen is presented, indicating that if you accept this change, the integrated SCSI controller will be changed to Second automatically. Press **Enter** to accept these changes.

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If you want the order of the integrated SCSI controller to be something other than Second, scroll (usually down) to the Embedded Compaq Integrated Controller and set the Controller Order manually, as described above.

When installing a SMART-2DH Controller in a system with an existing array controller, you can either place the new controller at the end of the controller order or reorder the controllers. Reordering changes the current drive letter assignments for all drives on the system. To avoid changing the drive letter assignments, place the new controller at the end of the controller order and do not create a primary partition on any of the added disks.

Online Recovery Server Status
This function indicates whether the SMART-2DH Controller is able to participate in Online Recovery and is available only in Advanced Features (**Ctrl+A** at the main menu).

Select:

Disabled	Online recovery is disabled
Primary	SMART-2DH Controller manages the local storage device.
Recovery	SMART-2DH Controller is able to adopt a storage device from another system that has had an online recovery event occur.

PCI Memory Overlay Setting
This function indicates whether the allocated memory associated with multiple SMART-2 Array Controllers is overlaid or not.

NOTE: This feature is not compatible with Windows NT. For Windows NT, PCI Memory Overlay should be set to No Overlay.

This feature is available in Advanced Features (**Ctrl + A** at the main menu). This feature applies only to systems that:

- Contain more than 3 GB of RAM
- Contain more than one SMART-2 controller

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If your SMART-2 Array Controllers have 4-MB Array Accelerator boards, each installed SMART-2 Array Controller will consume 32-MB of physical memory space. If your SMART-2 Array Controllers have 16-MB Array Accelerator boards, each installed SMART-2 Array Controller consumes 128-MB of physical memory space. The amount of consumed address space may be reduced by modifying the PCI Memory Overlay Setting or changing the switch setting on the Array Accelerator board.

a. Modifying the PCI Memory Overlay Setting:

- No Overlay: Select this to not use the overlaying feature.
- Overlay 32 MB: Select this if your controller has a 4-MB Array Accelerator board to reduce the amount of consumed physical memory to 32 MB, regardless of the number of SMART-2 Array Controllers installed.
- Overlay 128 MB: Select this if your controller has a 16-MB Array Accelerator board to reduce the amount of consumed physical memory to 128 MB, regardless of the number of SMART-2 Array Controllers installed.

b. Changing the Switch on the Array Accelerator Board

- If your SMART-2DH Array Controller has a 16-MB Array Accelerator board, the amount of memory consumed per controller can be reduced to 32 MB by changing the switch setting on the Array Accelerator from 16 MB to 4 MB, as shown in Figure 4.1. This change works for all operating systems.

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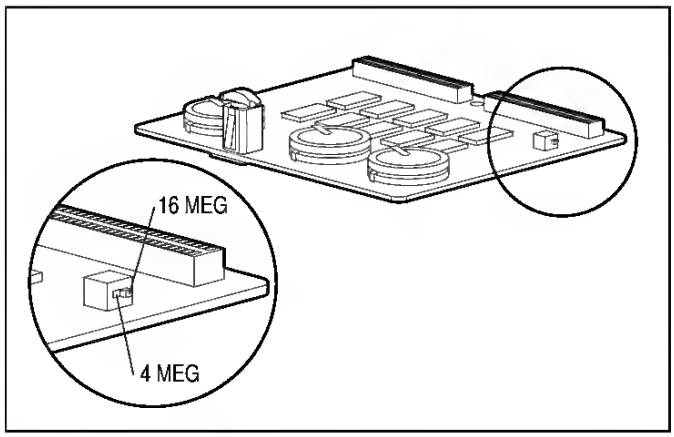

Figure 4-1. **Array Accelerator switch positions**

2. Review and edit the Controller Characteristics of all other SMART-2DH Controllers shown in the View or Edit Details screen, as described in Step 11 above.
3. Press **F10** when finished editing the View or Edit Details screen.
4. Select Step 5: Save and Exit on the Steps in Configuring Your Computer screen.
5. Choose Save The Configuration and restart the computer on the Save and Exit screen.
6. Press **Enter** at the Reboot screen.
7. Remove the CD or System Configuration diskette and verify that the server will boot normally without POST errors.

System hardware configuration is complete. Proceed to Chapter 5, "Running the Array Configuration Utility," to configure drive arrays.

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Chapter 5
Running the Array Configuration Utility

This chapter provides instructions for using the Compaq Array Configuration Utility and describes methods (wizards) you can use to configure your controller quickly and easily. The chapter is divided into the seven sections, as listed below. You should read the first five sections and use the last two sections as reference material when needed.

- Before You Begin
- Starting the Compaq Array Configuration Utility
- Configuration Wizards
- Online Help
- Configuration Procedures
- Array Configuration Utility screens
- Errors and Warnings

The Array Configuration Utility, which is located on the SmartStart and Support Software CD, is a graphics-based application that helps you configure the Compaq SMART-2DH Array Controller. You can use the Array Configuration Utility to configure the SMART-2DH Array Controller initially, to add additional disk drives to an existing configuration, or to reconfigure your array controller.

The Array Configuration Utility provides the following configuration benefits:

- Illustrates the controller configuration in an easy-to-understand, graphical format
- Provides descriptions of various configuration errors
- Contains configuration wizards that walk you through the configuration process
- Suggests optimal configuration and fault tolerance for unconfigured controllers

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Before You Begin

During a first-time installation and configuration of the SMART-2DH Array Controller, you should complete the following tasks:

1. Install the SMART-2DH Array Controller board.
2. Update the system ROM with System ROMPaq.
3. Run Option ROMPaq to update the controller firmware, option ROM, and drive firmware.
4. Run the System Configuration Utility to verify the controller order settings.
5. Decide which fault-tolerance method and array configuration you want to use.

Starting the Array Configuration Utility

You can access and start version 1.10 of the Array Configuration Utility in the following ways: online, system partition, SmartStart and Support Software CD, and, diskettes.

Accessing Online

If the server you are configuring is running under Windows NT or NetWare, you can install and run the configuration utility online.

Windows NT

When you install the Windows NT Software Support Diskette (SSD), it prompts you to insert the second Array Configuration Utility diskette to install the utility. A program icon is automatically created. Select the icon to run the Array Configuration Utility. The Windows NT online Array Configuration Utility requires that at least one logical drive was previously configured while offline.

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NetWare

The Compaq Array Configuration Utility for NetWare (*CPQONLIN.NLM*), is available on the NetWare Programs from Compaq (NPFC) diskettes in the \DRV_ARRY directory. Generate the NPFC diskettes using the Diskette Builder feature in SmartStart. The NPFC diskettes have an *ARRAY.RDM* readme file to access instructions on loading and using *CPQONLIN.NLM*.

System Partition

If SmartStart has been run on the server before, the Array Configuration Utility program should already be installed on the system partition.

1. Power off, then power on the server.
2. When the cursor is in the upper-right hand corner of the screen, press **10**.
3. Navigate through the menus to the Array Configuration Utility program.

SmartStart and Support Software CD

You can run the Array Configuration Utility directly from the SmartStart and Support Software CD.

1. Insert the SmartStart and Support Software CD in the CD drive and power up the server. A menu is displayed.
2. Select Configure Hardware from the menu, then select the Array Configuration Utility.
3. After completing the configuration, remove the CD and restart the server.

Array Configuration Utility Diskettes

You can run the Array Configuration Utility from diskettes made using the Diskette Builder feature on the SmartStart and Support Software CD.

1. Boot the server from the Compaq SmartStart and Support Software CD.

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2. From the Compaq System Utilities screen, select Create Support Software.

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3. From the Diskette Builder screen, scroll down the list and select Compaq Array Configuration Utility for Microsoft Windows and Windows NT.
4. Follow the instructions on the screen to create the diskette(s). (See "Using the Array Configuration Utility Diskettes.")

Using the Array Configuration Utility Diskettes

To use the Array Configuration Utility diskettes:

1. Insert the Array Configuration Utility diskette number 1 into the disk drive.
2. Restart the server.

Configuration Wizards

When you start the Array Configuration Utility, the software checks the configuration of each SMART-2DH Array Controller board and its drive arrays. If the arrays are unconfigured *or* if the configuration is less than optimal, the configuration wizard takes over to guide you through the configuration process. The configuration wizard recognizes the following conditions:

- *Unconfigured controller* - When the Array Configuration Utility detects an unconfigured controller, the configuration wizard takes you through the controller configuration process.
- *Unused physical drives* - When the Array Configuration Utility detects unused physical drives, the configuration wizard provides an easy way to add them to an array. The "capacity expansion" capability of the SMART-2DH Array Controller allows the Array Configuration Utility to add the new physical drives to an existing array without destroying the data on the existing logical drives.
- *Unused space on an array* - If the Array Configuration Utility detects unused capacity in an array, the configuration wizard takes you through the process of configuring the space into one or more logical drives.

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Online Help

Press the **F1** key or the click the Help button to activate context-sensitive help for each screen. A status bar at the bottom of the screen also provides immediate help messages describing the current selection.

Configuration Procedures

Creating a New Array

If you are configuring a new array, the configuration wizard leads you through the process. If you want to bypass the wizard, use the following procedures to create your array.

Creating a New Array—Procedure

Creating a new array involves the following general steps:

1. Choose a controller for the array.
2. Group physical drives of the same size into an array.
3. Subdivide the array into one or more logical drives.

The following example illustrates using the Array Configuration Utility to carry out these steps.

Creating a New Array—Example

For this example, make the following assumptions:

- Four 1.05-GB drives and two 4.3-GB drives are connected to the SMART-2DH Array Controller.
- There will be two arrays. Array A consists of three 1.05-GB drives with the fourth 1.05-GB drive used as a spare. Array B is the two 4.3-GB drives.

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- The fault-tolerance method for all logical drives on Array A is RAID 5, Distributed Data Guarding. The fault tolerance method for all logical drives on Array B is RAID 1, Drive Mirroring.

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Choose a controller for the array

1. In the Array Configuration Utility Main Configuration Screen, select the Controller Select box. You can also select Controller/Select... from the main menu.
2. Select one of the listed controllers.

Figure 5-1. **Controller Select list**

3. Click the Controller Settings button shown in Figure 5-2.

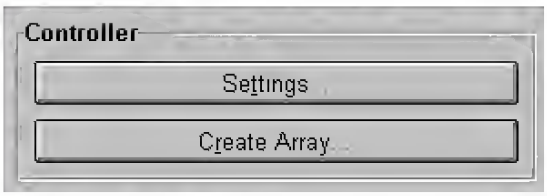

Figure 5-2. **Controller buttons**

The controller settings screen is displayed, as shown in Figure 5-3.

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4. Select the correct operating system on the controller settings screen.

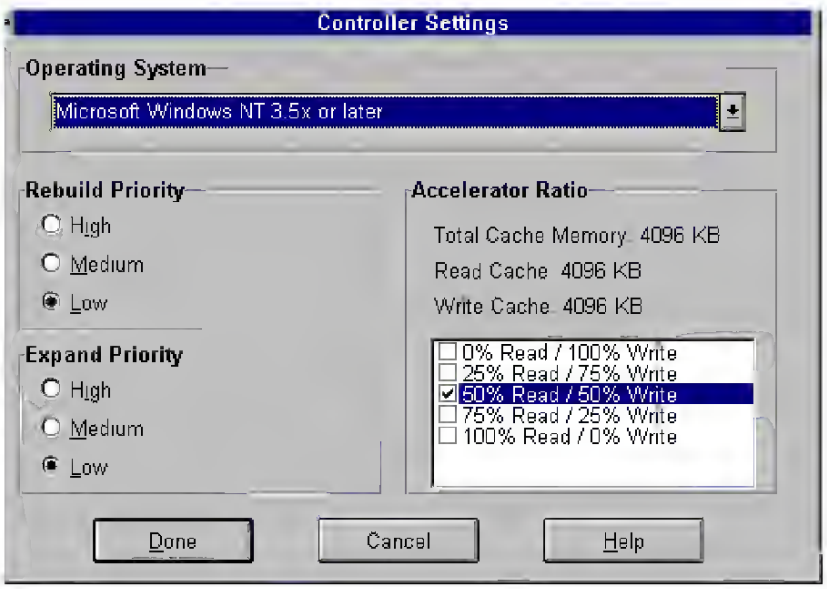

Figure 5-3. **Controller Settings screen**

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Group physical drives of the same size into an array

5. Click the Create Array... button. The Create Array screen is displayed.

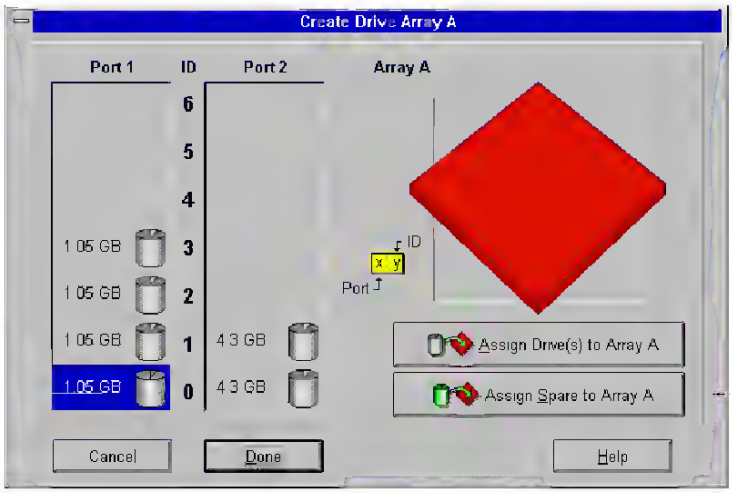

Figure 5-4 **Create Array screen**

NOTE: Always group physical drives of the same size. The SMART-2DH Array Controller treats all the drives as the same size as the smallest drive in the same array. If you mix drive sizes, the capacity of the larger drives is wasted.

6. Select the three drives you want to make up the array from the drives on the left. For this example, select the following drives:
   Port 1:SCSI ID 0
   Port 1:SCSI ID 1
   Port 1:SCSI ID 2
   Click the Assign Drive(s) to Array button.

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7. Select the drive at Port 1:SCSI ID 3 and click the Assign Spare to Array button. The right side of the Create Array screen should now look similar to the following figure.

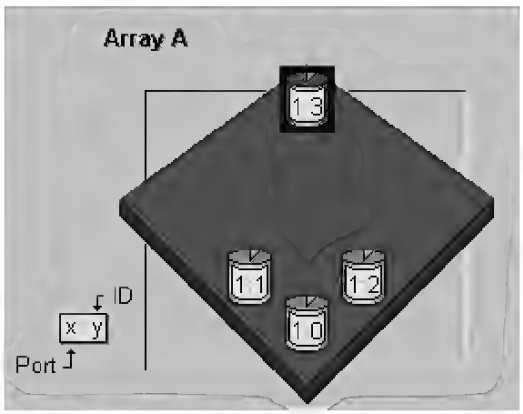

Figure 5-5. **Example Array A**

NOTE: The same spare drive may be assigned to multiple arrays. However, spare drives should have the same or larger capacity than the drives in the array.

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8. Click the Done button to return to the Main Configuration screen. The Logical Configuration View area should now look similar to the following figure.

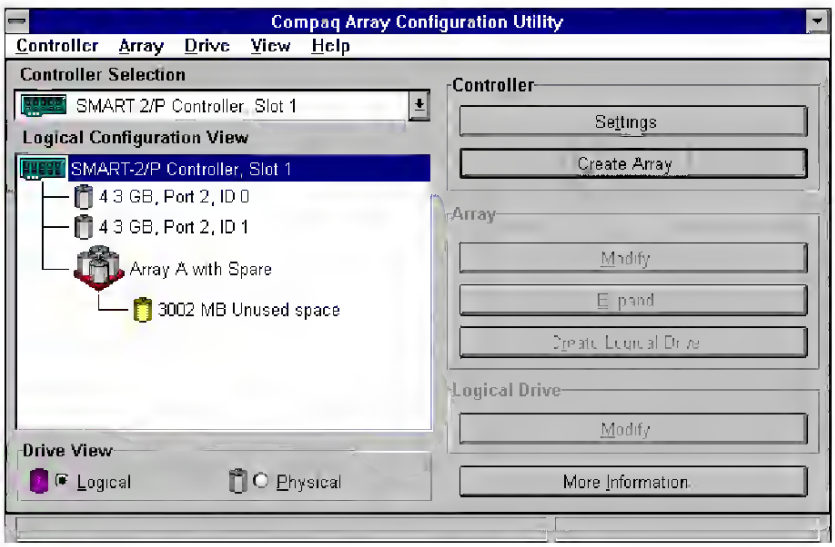

Figure 5-6. **Example Array - Logical Configuration View with 1 Array**

9. Select the controller, then click the Create Array button to create Array B.

10. Assign both 4.3-GB drives to the array. Click the Done button.

NOTE: In this example, each array was created using drives from the same SCSI Port. You can achieve better performance by selecting drives from both ports for an array, assuming you installed the correct drives in both ports before you ran the Array Configuration Utility.

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Create logical drives across the physical drives in the array

When creating a logical drive, you can select a fault-tolerance (RAID level) option and provide information regarding the drive size and array accelerator.

1. Select Array A or the Unused Space icon under Array A in the Logical Configuration View.
2. Click the Create Logical Drive button. A screen similar to the following figure is displayed.

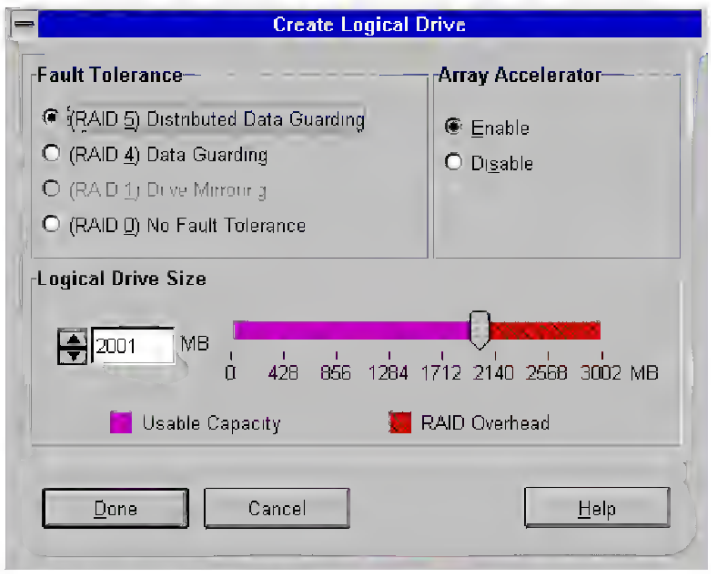

Figure 5-7. **Create Logical Drive screen**

3. In the upper-left area of this screen, click the Distributed Data Guarding (RAID 5) button.
4. Click the Array Accelerator Enable button.
5. The Logical Drive Size area shows a graphical representation of the storage capacity available. To create a single logical drive across this array, accept the default values. See the section titled "Create Logical Drive Screen" later in this chapter for a detailed description of this screen.

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6. Click the Done button.
7. Select Array B or the Unused Space icon under Array B in the Logical Configuration View.
8. Repeat steps 12 through 16 to create a single logical drive on Array B, this time selecting RAID 1 fault tolerance.
9. The Configuration View screen should now look like the following figure.

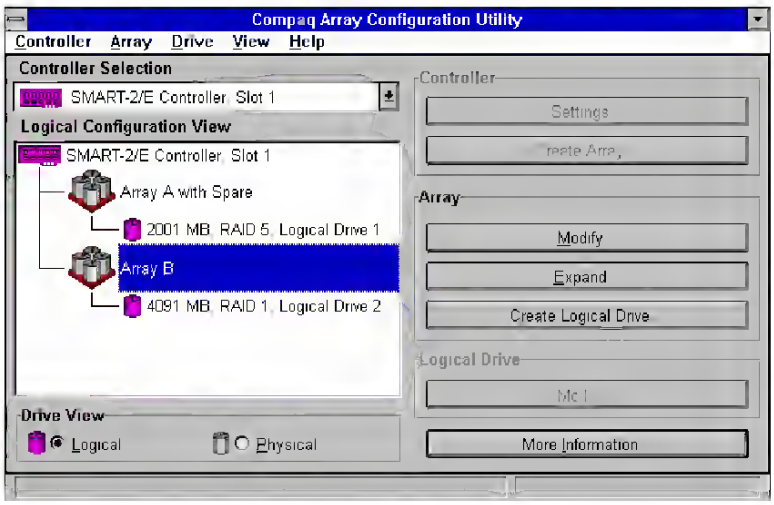

Figure 5-8. **Example array - Configuration View screen with two arrays**

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Capacity Expansion

Capacity expansion involves adding storage capacity to an array that has already been configured. If an existing array is nearly full of data, you can expand the capacity without disturbing the existing data. The SMART-2DH Array Controller capacity expansion feature provides a way to add a new physical drive to the array.

When you run the Array Configuration Utility, the program checks the drive hardware and configuration. If the Array Configuration Utility discovers a physical drive that is not being used, the configuration wizard leads you through the steps of adding the drive.

NOTE: You cannot use the Capacity Expansion feature if the disk controller is configured for use with the Recovery Server option. In order to expand an array when the controller is configured for the Recovery Server option:
1. Use the System Configuration Utility to turn off the Recovery Server feature,
2. Enter the Array Configuration Utility and use the capacity expansion feature,
3. After the expansion is complete, use the System Configuration Utility to enable the Recovery Server feature.

Capacity Expansion Procedure

If you wish to bypass the configuration wizard for some reason, you may use the procedures that follow to expand your array.

- Install the new physical drive(s).
- Assign the new physical drive(s) to an existing array. Existing logical drive(s) will automatically expand across all of the physical drives, including the newly added one(s).
- Create a new logical drive to use the extra space on the expanded array.

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Capacity Expansion Example

In this example, assume a configuration similar to the previous example except that the fourth 1.05-GB drive was added later. Now you want to expand Array A to include the fourth drive. This scenario is shown in the following figure with a single 1.05-GB drive unassigned.

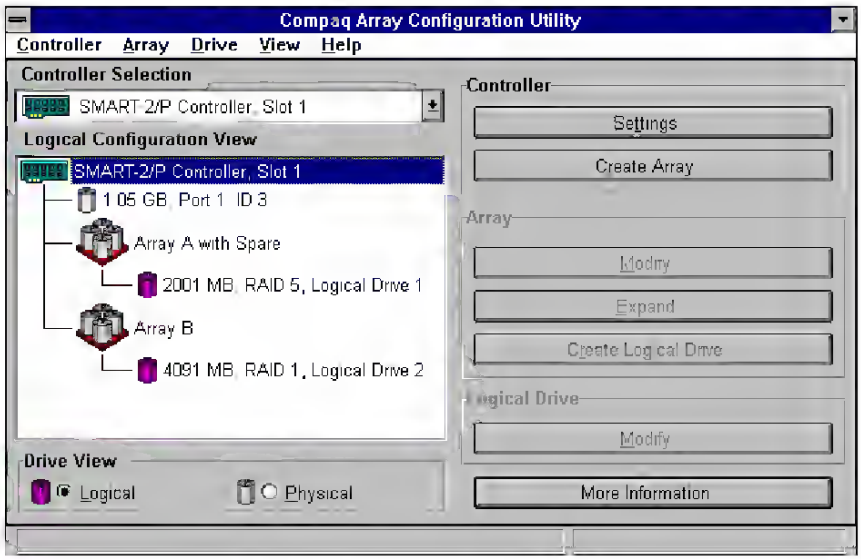

Figure 5-9. **Array expansion example - Configuration View screen**

To expand the capacity of Array A and create logical drive 2, complete the following steps:

1. Select Array A.
2. Click the Expand button.
3. Select the unassigned 1.05-GB drive.
4. Click Assign Drive(s) to Array button.

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5. Click the Next button at the bottom of the screen. A screen similar to the following figure is displayed.

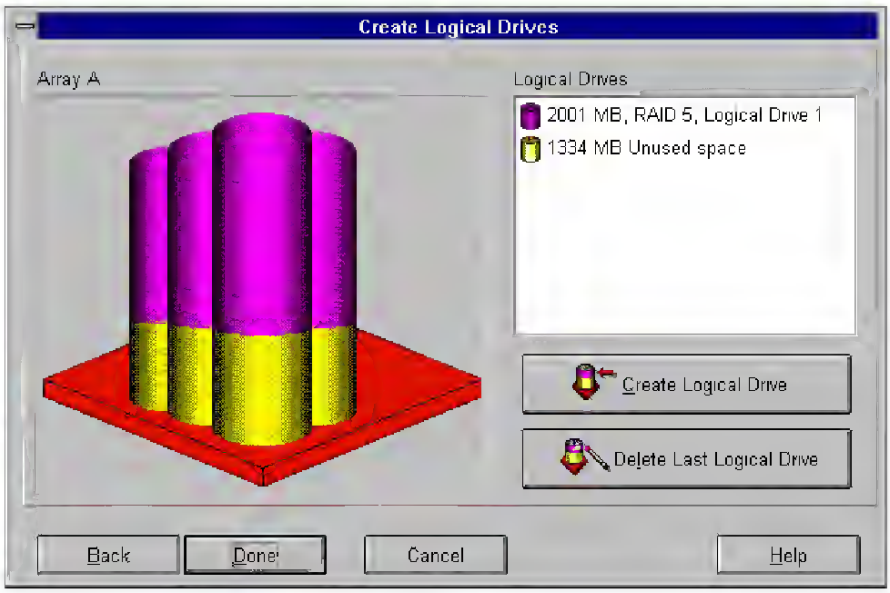

Figure 5-10. **Expansion Wizards - Logical Drive Screen**

6. Click the Create Logical Drive button.
7. Set the fault tolerance, array accelerator, and size for logical drive 2.
8. Click the Next button.
9. Click the Done button.
10. At the main screen, select Controller, Save. This will save the new settings for logical drive 2 and start the capacity expansion process.

NOTE: Logical drive 2 will not be accessible until the capacity expansion process has completed on logical drive 1.

CAUTION: In case of power loss, capacity expansion process information is temporarily stored in the array accelerator memory. Do not interchange SMART-2DH Controllers or Array Accelerator boards during a capacity expansion process to prevent the loss of

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data in the expanding logical drive.

Array Configuration Utility Screens

Main Configuration Screen

The main configuration screen is the first screen displayed after the configuration wizard has been completed. As you select certain items, some areas are highlighted while others appear gray. You cannot select grayed-out areas until you select an item in the list box providing that option.

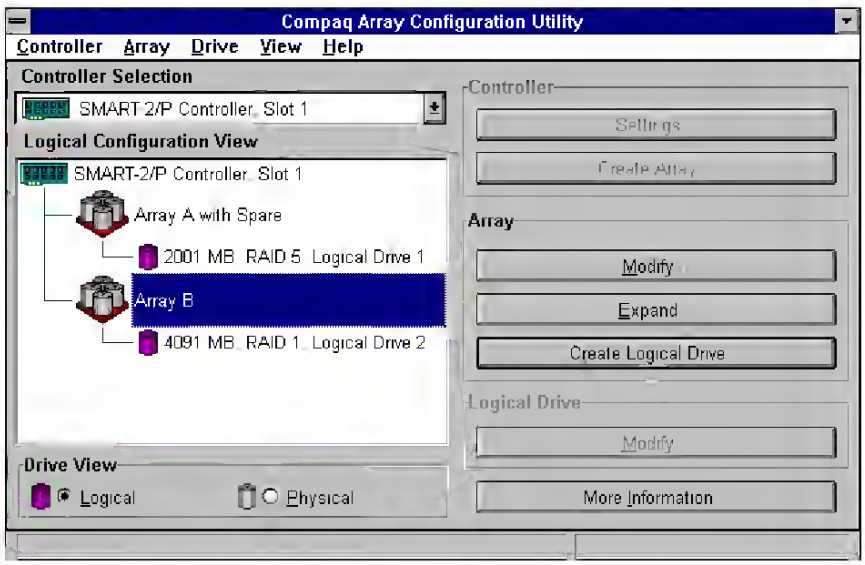

Figure 5-11. Main Configuration screen

Elements of the Main Configuration screen are described in the following paragraphs.

Menu Bar

The menu bar contains the following pull-down menus:

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- Controller - lets you to perform tasks such as selecting a controller, saving a configuration, creating an array, and exiting the program.
- Array - lets you to delete, change, or expand the capacity of an array; also you to create logical drives.
- Drive - lets you to delete or change logical drives, assign physical drives to arrays, and create online spares.
- View - lets you to switch between the Physical Drive View or the Logical Drive View in the list box.
- Help - lets you to select the help contents, search, and other online help.

Controller Selection Box

The Controller Selection box is located in the top left corner of the main configuration screen. When you select this, a drop-down box lists all the controllers installed in the present system. You can select which controller you would like to view or configure. The highlighted controller is shown in detail in the View Configuration list box.

Figure 5-12. **Controller Selection box**

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Logical/Physical Configuration View List Box

The Logical Configuration View list box provides a graphical representation of all the drives and arrays associated with the selected controller. Located next to each controller icon is the name of the controller and the slot in which it is installed.

For each controller, the drive arrays, logical drives, and physical drives associated with that controller are listed. Use the Drive View buttons, located below the Logical Configuration View list box, to select either the Physical or Logical view.

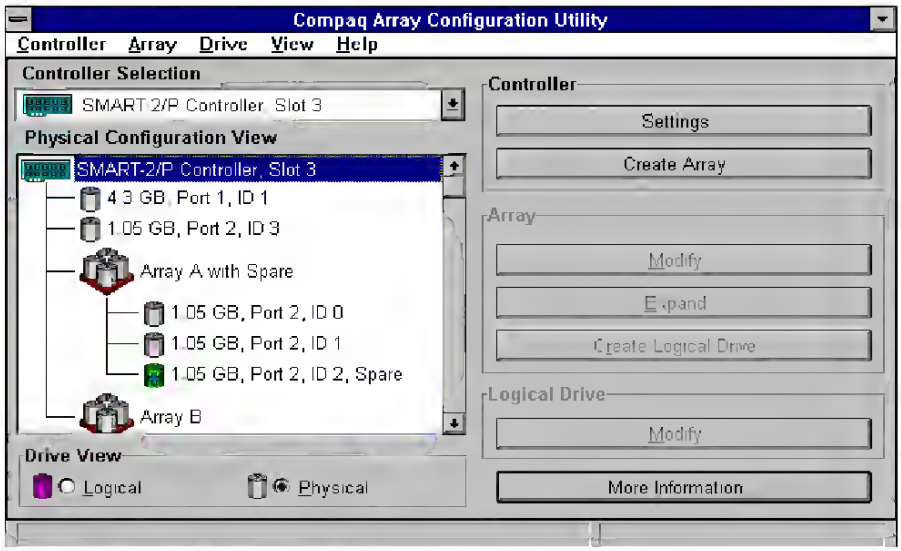

Figure 5-13. **View Configuration List box**

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Figure 5-13 shows an example of a physical view of a SMART-2DH Array Controller in slot 3. Listed below the controller are two unassigned drives, one 4.3-GB drive and one 1.05-GB drive. This controller has two drive arrays, named Array A and Array B, along with a number of drives within each array. Array A has an online spare.

NOTE: When viewing the configuration list box, selecting an item—a controller, array, logical drive, or physical drive—will cause the drive tray LEDs to blink. Use this feature to identify a specific physical drive, i.e., the spare, or to identify the external drives attached to a controller. This feature works with firmware versions 1.50 or greater.

More Information Button

The More Information button, shown in Figure 5-14, is located at the bottom right side of the screen. Click this button to display a list of all the controller, drive, and array configuration details available for the selected items.

Drive View Buttons

This box, shown in Figure 5-14, is located at the bottom left side of the screen. The Drive View box lets you to switch between the logical and physical drive views. Select which representation you would like to see in the View Configuration list box.

Figure 5-14 **More Information and Drive View buttons**

Controller Buttons

The top right corner of the screen contains the Controller box, which becomes active after you select a controller in the Controller Select box.

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Figure 5-15. **Controller box**

Click the Settings button to display the Controller Settings screen (see the section titled "Controller Settings Screen," later in this chapter). Click the Create Array button to display the Create Array screen (see the section titled "Create Array Screen" later in this chapter).

Array Buttons

The Array box is located on the right side of the screen, under the Controller box. It becomes active after you select an array in the View Configuration list box.

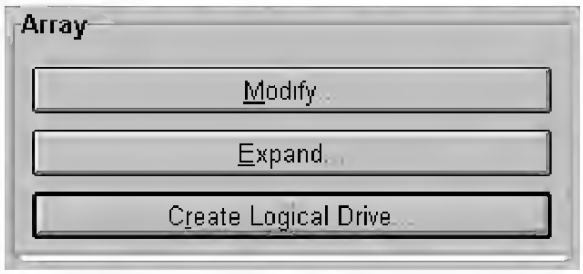

Figure 5-16. **Array buttons**

Logical Drive Buttons

This box is located on the right side under the Array box. It becomes active after you select a logical drive in the Configuration View list box.

Figure 5-17. **Logical Drive buttons**

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Controller Settings Screen

In this screen (Figure 5-18), select the operating system and set the Rebuild Priority, Expand Priority, and Accelerator Ratio. Rebuild and expand priority selections have no impact on an "idle" system but will impact performance on a "busy" system.

The Rebuild Priority affects the amount of time the controller spends rebuilding data after a failed drive has been replaced. Select High if rebuilding data should take precedence over handling requests from the operating system. Select Low if the controller should rebuild data only when it is idle.

The Expand Priority affects when the controller moves data after you have chosen to expand the capacity of an array. Select High if expanding the array capacity should take precedence over handling requests from the operating system. Select Low if the controller should expand the array capacity only when it is idle.

The Accelerator Ratio determines the amount of memory allocated to the read and write caches. Some applications may perform better with a larger write cache and others may perform better with a larger read cache.

NOTE: This feature works with both 4-MB and 16-MB Array Accelerator boards.

Use the Controller Settings Screen to select the Operating System, set the Rebuild Priority, Expand Priority, and Accelerator Ratio.

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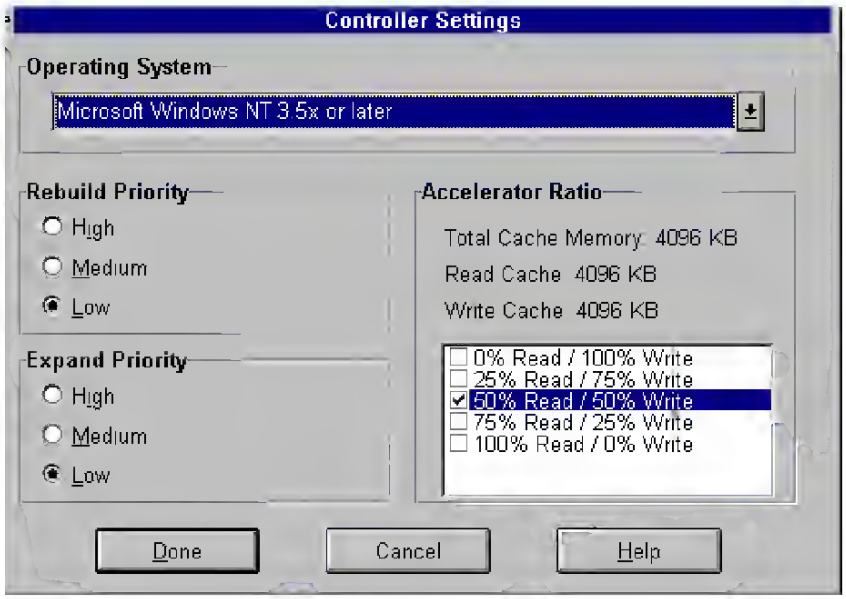

Figure 5-18. **Controller Settings screen**

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Create Array Screen

In this screen, all of the available drives attached to the selected controller are listed in the Port columns. The rows in the columns correspond to the SCSI ID of the drives.

To create an array, select the drives to be part of the array, then click the Assign Drive to Array button. To assign a spare, select the drive to be the spare and then click the Assign Spare to Array button.

Always group physical drives of the same size. If you mix drive sizes, the SMART-2DH Array Controller treats all the drives as the same size as the smallest drive in the array. This results in wasted capacity in the larger drives.

To increase performance, select drives from both ports and install the correct drives on both ports before running the Array Configuration Utility.

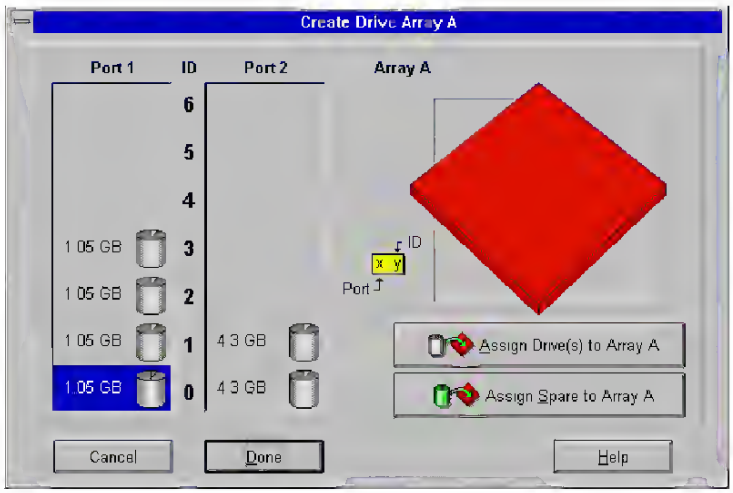

Figure 5-19. **Create Array screen**

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Create Logical Drive Screen

In this screen, you can select the fault-tolerance method, enable the array accelerator, and set the logical drive size.

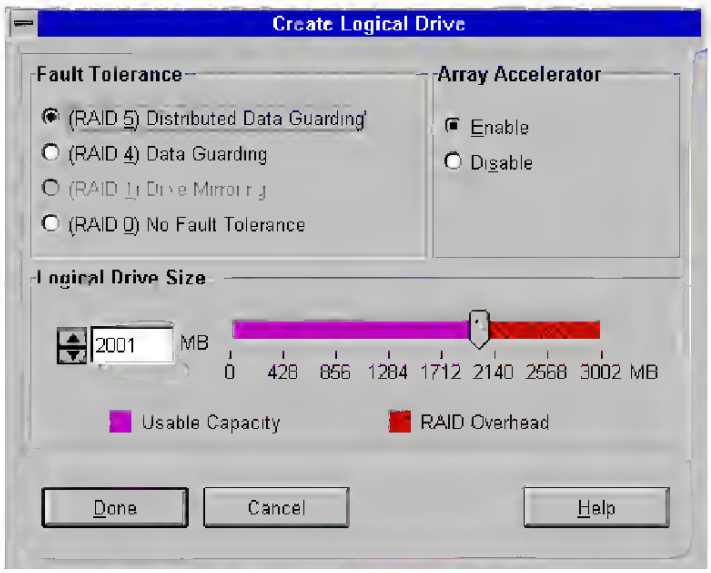

Figure 5-20. **Create Logical Drive screen**

The Logical Drive Size area shows a scale marked with the amount of drive capacity available for a logical drive. The utility does not allow you to create a logical drive larger than the maximum supported by the operating system.

The purple (left) band above the scale indicates the fraction of the total that is available for data. The red (right) band indicates the fraction required for storing the parity or mirrored information, depending on the fault-tolerance method used. The red (right) band is only needed for RAID 1, RAID 4, or RAID 5.

This screen is first displayed showing the maximum-sized logical drive that can be created for your drive array. You can reduce this amount if you want to create more than one logical drive on the array. To reduce the size, type the number in or drag the pointer to the left. Fine tune the size with the arrow buttons to the left of the scale.

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Error and Warning Messages

When you start the Array Configuration Utility, the software checks each controller to detect errors in its configuration. If a problem is found, the Array Configuration Utility displays an error or warning message that describes the problem. Error and warning messages include instructions to correct configurations. If a warning message indicates "Internal Error Has Occurred" and cites an error code number, the problem requires assistance from Compaq technical support. See "About This Guide" at the beginning of this book for technical support phone numbers.

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Chapter 6
Installing the Operating System Drivers

This chapter outlines the driver installation steps to set up the SMART-2DH Array Controller in a server running any of the following operating systems:

- Novell NetWare/intraNetWare
- Microsoft Windows NT
- SCO OpenServer 5
- SCO UnixWare 2.1 or later
- IBM OS/2
- Banyan VINES
- Microsoft Windows 95

This chapter also contains related information for using the SMART-2DH Array Controller with these operating systems. If you are setting up a new system, we encourage you to use SmartStart, supplied with the server, to install both the operating system software and the device drivers for the SMART-2DH Array Controller.

> **NOTE:** If you install the operating system software from the SmartStart and Support Software CD, all of the software, including device drivers, will be automatically installed and configured for the SMART-2DH Controller. In addition, the optimization supplied by the CPQDAOPT.NLM will occur automatically. The SMART-2DH Controller is supported by SmartStart 3.40 or later. See the documentation that came with SmartStart for installation instructions.

Before installing the drivers, you should have:

- Updated your system firmware by running System ROMPaq
- Installed the SMART-2DH Controller option board
- Configured the hardware by running the System Configuration Utility

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- Used the Array Configuration Utility to configure your drive array(s)

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Novell NetWare/intraNetWare

Use the instructions in this section to install the driver for a new SMART-2DH Controller installation or to upgrade the driver in a server running NetWare/intraNetWare and using the SMART-2DH Controller. If you use SmartStart to install NetWare/intraNetWare and drivers, you do not need to create the Novell Support Software Diskettes (SSD) and can skip to the section "Handling Disk Drive Failures."

Materials Needed

You will need the following items to manually install the SMART-2DH Controller driver on your server:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Array Controller Option Kit)
- Up to four blank diskettes
- Any server or workstation with a bootable CD-ROM drive

Creating Novell SSD Diskettes

Two NetWare/intraNetWare drivers for the SMART-2DH Array Controller—CPQDA386.DSK v 3.10 or later and CPQARRAY.HAM—are located on the Compaq SmartStart and Support Software CD that was supplied in the SMART-2DH Array Controller Option Kit.

NOTE: To determine the appropriate driver—CPQDA386.DSK or CPQARRAY.HAM—for your version of NetWare/intraNetWare see the online help file on Disk 2 of Novell SSD.

Use Disk 4 of Novell SSD to access the latest drivers and documentation for Compaq options in a NetWare/intraNetWare environment. To create the diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.

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3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Support Software for Novell Products.
5. You may create all of the disks in the Novell SSD set or create only disk 4, which contains the driver for the SMART-2DH Controller. We recommend you create all disks to obtain the support documentation. Follow the instructions on the screen to create the Novell SSD diskette(s).

Additional Information

Novell SSD Disk 2 contains the latest information about using Compaq options in a NetWare/intraNetWare environment, including the driver installation procedure. Locate and read this procedure. If the procedure differs from the one shown here, use the one in the *STORAGE.RDM* file on the Novell SSD diskette.

To read these text files:

1. Execute *README.COM* to view and print the readme files.

```
C:\readme
```

2. Select the file(s) to read or print. Important readme files include:
   - *READ1ST.RDM*
   - *STORAGE.RDM*

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Installing the Driver

The following steps outline the procedure to install the SMART-2DH Controller driver on your NetWare/intraNetWare server.

1. Boot the server.
2. From the DOS prompt, copy the CPQDA386.DSK (version 3.10 or later) or the CPQARRAY.HAM driver file from the \DRV_ARRY directory on the fourth Novell SSD diskette to the primary DOS partition on the boot drive in the server. This is where the NetWare/intraNetWare server files are located, usually drive c:

```
copy A:\drv_arry\cpqda386.dsk  C:\nwserver
```

3. Edit the *STARTUP.NCF* file so that the driver loads automatically at system startup. With any DOS editor, add the following line:

```
load  cpqda386
```

4. Refer to NetWare/intraNetWare installation documentation for information about installing and mounting volumes associated with your new disk subsystem.

Driver installation is complete. If you are using Compaq Insight Manager, see the following section for information on updating the Insight Agents.

Latest Drivers

The latest drivers for future upgrades may be obtained from the Internet:

World Wide Web Go to http://www.compaq.com.

CompuServe Enter *GO COMPAQ* or go directly to the Compaq Forum.

America Online Use the navigation keyword *COMPAQ*.

Prodigy Use the *JUMP* navigation command followed by the keyword *COMPAQ*.

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Internet Go to *FTP.COMPAQ.COM* to access the Compaq anonymous FTP site. Enter "anonymous" for user name at the login prompt. Enter your full Internet E-mail address for the password.

Download Facility Dial 281-518-1418. Compaq offers direct modem access for downloading drivers and other software. A SoftPaq manager is available to provide information on the latest files.

Updating the Compaq Insight Manager Agents

If you are using Compaq Insight Manager, you will need to update the Insight Agents to support the new SMART-2DH Controller. If you used SmartStart 3.40 or later to install the operating system on a new SMART-2DH Controller installation or upgrade your driver in an existing installation, the agents were automatically updated for you by SmartStart. You will not have to manually update the agents.

If you did not use SmartStart 3.40 or later as part of your SMART-2DH Controller installation, you must manually update the Insight Agents. The correct agents can be obtained from your local Compaq Reseller or Authorized Compaq Service Provider. Refer to the documentation included with Compaq Insight Manager for the correct procedure for updating agents.

Installation of the Compaq SMART-2DH Array Controller is complete. Reboot the server to begin using the array controller.

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Using Array Configuration Utility for NetWare/intraNetWare (CPQONLIN)

The Compaq Array Configuration Utility is an NLM that allows you to configure your drive arrays without shutting down your server. CPQONLIN.NLM is located in the ONLINE directory of Novell SSD Disk 1. Load the NLM and follow the instructions on the screen to use this online utility to configure your drive arrays.

NOTE: The Compaq Array Configuration Utility requires CPQDA386.DSK v 3.10 or later or CPQARRAY.HAM.

Optimizing Array Controller Performance

To increase the performance of your disk subsystem(s) under NetWare 4.x, follow each of these steps before installing NetWare volumes or partitions.

- If you selected a fault-tolerance option, such as mirroring or distributed data guarding when using the Compaq System Configuration Utility, do not select mirroring while using *INSTALL.NLM*. The fault-tolerance capabilities of the SMART-2DH Controller provide performance improvements and automatic data recovery features.
- Novell recommends that you create volumes with a 64-KB block size and that you use the Block Sub-Allocation feature of intraNetWare. Using a large block size decreases the amount of RAM required to mount the volume, while Block Sub-Allocation allows intraNetWare to allocate disk space more efficiently.
- Use of linear memory provides the best performance in the intraNetWare environment. When you use the Compaq System Configuration Utility to configure your server with intraNetWare, the memory options default so that linear memory is used. To verify the setting, run the Compaq System Configuration Utility and view the Compaq Memory settings. Make sure that a linear option has been selected under the Base Memory option.

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Using the Compaq Drive Array Optimization Utility (CPQDAOPT)

Compaq recommends that you use the Compaq Drive Array Optimization Utility (*CPQDAOPT.NLM*) to optimize your drive arrays before creating partitions. CPQDAOPT is a utility designed to assist you in optimizing performance and can increase drive array performance by 20 to 40 percent. This is accomplished by adjusting the size of the Hot Fix Redirection Area of a partition to reduce the number of disk accesses. CPQDAOPT provides you with a formula specific to your configuration. You must use this information as you create a partition using *INSTALL.NLM*. If you installed NetWare/intraNetWare using SmartStart, it is not necessary to run this utility.

Using CPQDAOPT On New NetWare/intraNetWare Servers

Before you load CPQDAOPT on your new NetWare/intraNetWare server, make sure you have followed the instructions for installing NetWare/intraNetWare from CD found in the *INSTALL.RDM* file on Novell SSD Disk 1.

NOTE: Back up existing data before applying new settings to data volumes.

1. Start your NetWare/intraNetWare server.
2. Copy the CLIB.NLM and STREAMS.NLM files from the NetWare/intraNetWare Installation CD-ROM (D:\NW410\BOOT or D:\INTRANETWARE.312_____\C; where the line represents eight underscores) to the server's DOS partition before you begin installation.
3. Start the NetWare/intraNetWare installation. When loading drivers, be sure that you have the CPQDA386.DSK (version 3.10 or later) or CPQARRAY.HAM driver loaded.
4. When the "Create NetWare Partition" option appears, use the **Alt+Esc** key sequence to change to the console prompt and load CLIB:

```
load clib.nlm
```

5. Load CPQDAOPT.NLM from Novell SSD Disk 3:

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```
load A:\drv_arry\cpqdaopt
```

6. CPQDAOPT displays the registered disk devices it has located. Select the device where you will create a partition by using the cursor keys and press **Enter**.
7. CPQDAOPT determines if it is possible to optimize the alignment of data on the selected device. If so, it provides you with a formula for determining the size of the Hot Fix Redirection Area you should select when creating this partition. Make a note of the formula: even, odd, and so on.
8. In some cases, it may not be possible to optimally align the data on the partition by sizing the Hot Fix Redirection Area alone. CPQDAOPT may instruct you to create a small DOS partition on the device. If so:
   a. Exit from NetWare/intraNetWare before creating the partition.
   b. Use the DOS FDISK utility to create the smallest DOS partition allowed.
   c. Start the server and load CPQDAOPT.NLM again.
9. Use the **Alt+Esc** keys to return to the NetWare/intraNetWare installation process and select the option to create disk partitions. Use the formula recommended by CPQDAOPT to determine the number of Hot Fix Redirection Blocks for the partition installed on the selected device. Make sure that the number of blocks is the same as described by the formula. For example, if the formula was "even", any number that is even will work.
10. After the SYS volume is optimized and the NetWare/intraNetWare files are installed, copy the *CPQDAOPT.NLM* to the server's SYSTEM partition so that it is easily accessible for future optimizations. In the following example, F: is mapped to the server's SYSTEM partition. From a client logged into the server, type:

```
copy A:\drv_arry\cpqdaopt.nlm  f:\system\cpqdaopt.nlm
```


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Using CPQDAOPT on Existing NetWare/intraNetWare Servers

If CPQDAOPT is already installed in the server's SYSTEM directory, use the following steps to run the NLM.

1. Load the Compaq Drive Array Optimization NLM by executing the following server console command:

```
load cpqdaopt
```

2. If you receive an error while loading CPQDAOPT, it may indicate that your version of CLIB is earlier than v3.11c. Otherwise *CPQDAOPT.NLM* displays the registered disk devices it has located. Select the device where you will create a partition by using the cursor keys and press **Enter**.
3. CPQDAOPT determines if it is possible to optimize the alignment of data on the selected device. If so, it provides a formula for determining the size of the Hot Fix Redirection Area you should select when creating this partition. Make a note of the formula: even, odd, and so on.
4. In some cases, it may not be possible to optimally align the data on the partition by sizing the Hot Fix Redirection Area alone. CPQDAOPT may instruct you to create a small DOS partition on the device. If so:
   a. Shut down the server before creating the partition.
   b. Use the DOS FDISK program to create the smallest DOS partition allowed.
   c. Start the server and load *CPQDAOPT.NLM* again.
5. Use the formula recommended by CPQDAOPT to determine the number of Hot Fix Redirection Blocks to assign for the partition installed on the selected device. Make sure that the number of blocks is the same as described by the formula. For example, if the result of the formula was "even," any even number will work.
6. If you have already created a partition on a device, CPQDAOPT may be used to determine if the data is optimally aligned.

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7. You may receive a warning about changing the cache buffer size on your server. In some cases, increasing the size of the cache buffers on a NetWare/intraNetWare server may slow I/O performance.
8. If you must enlarge the cache buffer size and it takes the partition out of optimal alignment, or if CPQDAOPT informs you that the existing partition on a device is not optimally aligned, it is still possible to configure the partition optimally.
   a. Make a backup of the data on your server to avoid data loss.
   b. Use *INSTALL.NLM* Disk Options, Partition Tables, and Change Hot Fix Option to change the size of the Hot Fix Redirection Area using the formula provided by CPQDAOPT.
   c. Recreate your volume(s).
   d. Restore your data.

Software Drive Mirroring with NetWare/intraNetWare

If you use drive mirroring fault tolerance, be aware that NetWare/intraNetWare recognizes each logical drive in an array as a separate physical drive. If you mirror logical drives on the same array and a physical drive fails, both logical drives in the mirrored pair will fail and your data will be lost.

To avoid this problem, you must mirror logical drives on separate arrays. Use the Compaq Array Configuration Utility for NetWare/intraNetWare (CPQONLIN.NLM) on Novell SSD Disk 3 to view the logical configuration for the SMART-2DH Array Controller. Record which logical drives reside on which arrays. When configuring NetWare/intraNetWare for drive mirroring, select equally sized logical drives on different arrays.

IMPORTANT: NetWare will not be able to warn you if you mirror logical drives which share a physical drive because NetWare cannot distinguish the individual physical drives. If you do not have at least two arrays, you should not use NetWare drive mirroring.

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Handling Disk Drive Failures

Although drive failures are not common, they may occur; it is important to protect your critical data. The best way to recover from a failed drive is to configure your drive system with some form of fault-tolerance.

To ensure a quick and transparent recovery, Compaq recommends that you configure your SMART-2DH Controller with hardware fault tolerance. An advantage of hardware fault tolerance is that the controller is able to perform a background surface analysis on the hard drives to monitor for bad sectors and remap data to a new location on the media. This feature enhances the reliability and availability of your data. Compaq also recommends that you use good backup procedures, in case of catastrophic failure.

If you discover a failed drive, perform the following steps:

- Identify and document which physical drive has failed. Note the drive type and capacity.
- Note which partition and volume, if any, has failed. This information is provided in the error message on the server console. It is also recorded in the server error log file which may be viewed using the SYSCON utility (intraNetWare 3.12) or NWADMIN utility (NetWare 4.x).
- Make sure that you have a recent backup. If the drive is part of a fault-tolerant mirrored volume, or a hardware fault-tolerant volume, you will be able to backup the data again in case of a second drive failure.
- Locate a replacement drive of the same type and capacity.
- Follow the instructions in the sections below for replacing a drive for your particular server configuration.

DOS Partitions and NetWare/intraNetWare Fault Tolerance

NetWare/intraNetWare does not mirror information on DOS partitions. Only hardware fault tolerance supports mirrored DOS partitions. If you have a mirrored drive containing a DOS partition, you need to restore the DOS partition information from another backup source.

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If the failed drive contains a DOS partition, NetWare/intraNetWare will not be able to access information on that partition. For example, files on the DOS partition include STARTUP.NCF and Novell disk drivers. To prevent NetWare/intraNetWare from attempting to read from or write to the failed device, execute the following command from the console.

```
REMOVE DOS
```

Recovering a DOS Partition Without Hardware Fault Tolerance

If your server is not configured for hardware fault tolerance, and if the drive that failed contained the DOS partition used to boot your server, you will not be able to restart the server once it has been powered off. Schedule maintenance time as soon as possible and complete the following:

1. Power down your server.
2. Replace the failed drive.
3. Reboot the system with the Compaq System Configuration Utility diskette.
4. Select the option to install a System Partition on your DOS boot device. This partition should contain the Compaq System Configuration Utility and the Compaq Diagnostic Utility. Exit the System Configuration Utility.
5. Locate a DOS bootable diskette that contains the DOS FDISK and FORMAT programs.
6. Use the FDISK program to create a primary DOS partition on the replaced drive. Compaq recommends that your DOS partition be at least 15 megabytes.
7. Set the active partition to the DOS partition you just created.
8. Use the FORMAT command to format the DOS partition to include the necessary files to make the partition bootable. For example:

```
FORMAT C: /s
```


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9. If you have a backup of your DOS partition, use it to recreate the previous image. Otherwise, use your NetWare/intraNetWare server diskettes and copy the following files to a NetWare/intraNetWare directory on your DOS partition:

   SERVER.EXE
   INSTALL.NLM
   VREPAIR.NLM
   MONITOR.NLM
   CLIB.NLM
   STREAMS.NLM

10. Copy the required disk drivers, LAN drivers, and utility NLMs that should reside on the DOS partition from the Novell SSD.

11. Copy any other necessary information to the DOS partition and then reboot your system. You are now ready to start your NetWare/intraNetWare server. You may need to recreate your *STARTUP.NCF* file.

Recovering Drives Configured for Hardware Fault Tolerance

If you configure your SMART-2DH Array Controller with hardware fault tolerance, complete the following steps after a disk drive failure.

1. Determine which physical drive failed. On hot-pluggable drives in a ProLiant server or storage system this is done by observing the amber Drive Failure LED on each drive tray.

2. If the unit containing the failed drive does not support hot-pluggable drives, perform a normal system shutdown.

3. Remove the failed drive and replace it with a drive that is of the same capacity. For hot-pluggable drives, after you secure the drive in the bay, the LEDs on the drive will all light once in an alternating pattern to indicate that the connection was successful. The Online LED will blink indicating that the controller has recognized the drive replacement and begun the recovery process.

4. Power on the server, if applicable.

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5. The SMART-2DH Controller firmware will reconstruct the information on the new drive based on information from the remaining physical drives in the logical drive. While reconstructing the data on hot-pluggable drives, the Online LED will blink. The controller will signal that it has completed rebuilding the information on the drive by lighting the Online LED.
6. NetWare/intraNetWare has no knowledge of a single physical drive failure when using hardware-based fault tolerance; intraNetWare will find that the data is still valid and accessible during the rebuilding process.

Recovering Drives Configured for NetWare/intraNetWare Fault Tolerance

If you have chosen no fault tolerance for the drives connected to your SMART-2DH Controller and have configured NetWare/intraNetWare mirroring or NetWare/intraNetWare controller duplexing, use the following procedure to recover the data after a drive failure:

1. Identify the failed physical drive that caused the NetWare/intraNetWare device to be deactivated due to drive failure. Record the device number and device name of the failed logical drive. For example:

   ```
   Device #1 (47000) Slot 1 Disk 1 NFT
   ```

   The failure messages are recorded on the server console and also in the server error log file, which may be viewed using the SYSCON utility (3.12) or the NWADMIN utility (4.x). This information will be used later to recreate a valid partition.

2. Load the *INSTALL.NLM* and select the Disk Options Mirroring menu. Select the mirrored logical partition that was affected by the drive failure (step 1 above). Record the device number and partition number of the operational logical drive in this mirrored group. This information will be used later to remirror the repaired logical drive.
   For example:

   ```
   NetWare 386 Partition 3 on Device #2 (47110)
   ```


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3. Delete the unavailable (possibly out of sync) device from the Mirror Partition group. This device is unavailable due to the drive failure.
4. Record the drive bay location of the failed physical drive. This is the location is where the new physical drive must be inserted.
5. If the failed drive is hot-pluggable, skip to step 6. Otherwise, schedule server down time, bring down the server, and power off the unit.
6. Insert the replacement physical drive in the same drive bay where the failed drive was located. The physical drive must be the same capacity as the failed drive. Be sure that all cable connections are securely in place.

   For replacements in a ProLiant server or storage system, after you secure the drive in the bay, the LEDs on the drive will all light once in an alternating pattern to indicate that the connection was successful. The Online LED will turn green, indicating that the controller has recognized and successfully initialized the replacement drive. If the Online LED does not light after a few minutes, verify that you added the new drive in the same slot as the failed drive and that the drive capacity is the same as the failed drive it is replacing.

7. Activate the replaced device. Use *MONITOR.NLM* Disk Information option to select the device. Some versions of NetWare/intraNetWare will cause a "device activate" to occur automatically when this option is chosen. Other versions of NetWare/intraNetWare require manual activation of the device by changing the operating status to active. A console alert will be sent by the driver if attempts to reactivate the failed logical drive are successful.
8. Use the *INSTALL.NLM* option Change Hot Fix (look at the information provided about the mirrored drive, not the failed drive) to determine the number of Hot Fix Redirection blocks set up for this partition. See the section "Using CPQDAOPT on Existing NetWare/intraNetWare Servers" in this chapter for more information about optimizing the performance.
9. Use the *INSTALL.NLM* to delete and recreate the partition on the repaired logical drive.

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NOTE: Although the logical drive may have a valid partition table, the data on this logical drive is NO LONGER VALID. Some data may appear valid because the failed physical drive was only a portion of the arrayed logical drive. However, there is a hole in the logical drive data at this point. Delete any old, invalid data and recreate a new partition on the logical drive.

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10. Return to the *INSTALL.NLM* Disk Options menu. If you are not running intraNetWare SFT III or NetWare 4.x, you may be able to skip to step 11. Use the Mirroring selection to locate the Out of Sync partition. The device number for the Out of Sync partition should match the previously failed device number. Select the Out of Sync partition. Use the **Insert** key to resynchronize this partition. NetWare/intraNetWare requires you to resynchronize before deleting the partition. Allow INSTALL to resynchronize this partition. You may receive warning messages that the selected partition contains an already-defined volume and ask if you want to rename the volume. Select No and press **Esc**. Since you plan to delete this partition, there is no reason to salvage the volume. You should be able to proceed with deleting the partition table.

11. Using the *INSTALL.NLM* Disk Options menu, select the Partition Tables Option. In the *INSTALL.NLM* Available Disk Drives menu, select the previously failed logical drive, which has now been repaired. The device information should have been recorded in step 1 above. For example:

    ```
    Device #1 (47000) Slot 1 Dsk 1 NFT
    ```

    Select the Delete Partition option. INSTALL may show several error messages. Do not update any Volume Definition Table information because you will delete this partition anyway. Continue until the partition on this device has been deleted.

    If INSTALL reports that it cannot delete the partition because another process has it locked, load MONITOR and look at the System Resources option to determine which NLM has locked the device. It may be MONITOR.NLM, so you will need to unload MONITOR and any other NLMs that have the partition locked. After you have recreated the partition and volume information, reload those NLMs.

12. Recreate the partition on the same logical drive.

13. Return to the Disk Options Mirroring menu. Select the NetWare 386 Partition number that was previously mirrored. This partition was recorded in step 2 above.

    ```
    NetWare 386 Partition 3 on Device #2 (47110)
    ```

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14. Press **Insert** for a list of partitions available to remirror. Select the partition associated with the device (step 1) that was repaired. This step causes NetWare/intraNetWare to begin resynchronizing the mirrored partitions.
15. A console message indicates successful completion of the resynchronization step.

Recovering Drives Configured for No Fault Tolerance

If you have configured no fault tolerance, you must recover the data from a backup media. Perform the following steps:

1. Identify the failed physical drive that caused the logical drive to be deactivated due to drive failure. Record the device number and device name of the failed logical drive. For example:

   ```
   Device #1 (47000) Slot 1 Dsk 1 NFT
   ```

   The failure messages are recorded on the server console. They are also recorded in the server error log file, which may be viewed using the SYSCON utility (NetWare 3.12) or the NWADMIN utility (intraNetWare). This information will be used later to recreate a valid partition.

   For hot-pluggable drives in a ProLiant server or storage system, record the location drive bay of the failed physical drive. The failed physical device can be identified by the illumination of the amber LED on the drive tray. Note that this is where the new physical drive must be inserted.

2. Remove the failed drive.
3. Insert the replacement physical drive in the same drive bay where the failed drive was located. The physical drive must be the same capacity as the failed drive.

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For hot-pluggable drives, after you secure the drive in the bay, the LEDs on the drive will all light once in an alternating pattern to indicate that the connection was successful. The Online LED will turn green, indicating that the controller has recognized and successfully initialized the replacement drive. If the Online LED does not light after a few minutes, verify that you added the new drive in the same slot as the failed drive and that the drive capacity is the same as the failed drive it is replacing.

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4. It may be possible to use the *INSTALL.NLM* option Change Hot Fix to determine the number of Hot Fix Redirection blocks set up for this partition. Otherwise, see the section "Using CPQDAOPT on Existing NetWare/intraNetWare Servers" in this chapter for more information about optimizing the performance.

   NOTE: Even though the logical drive may have a valid partition table, the data on this logical drive is NO LONGER VALID. Some data may appear valid because the failed physical drive is only a portion of the arrayed logical drive. However, there is a hole in the logical drive data at this point. Delete any old, invalid data and recreate a new partition on the logical drive.

5. Return to the *INSTALL.NLM* Disk Options menu. Select the Partition Tables Option. At this point the driver should reactivate the failed logical drive. A console alert will be sent by the driver if attempts to reactivate the failed logical drive are successful. In the *INSTALL.NLM* Available Disk Drives menu, select the previously failed logical drive, which has now been repaired. The device information should have been recorded in step 1 above. For example:

   ```
   Device #1 (47000) Slot 1 Dsk 1 NFT
   ```

   Select the Delete Partition option. INSTALL may present several error messages. Delete the volume associated with this partition. Do not update any Volume Definition Table information because you will delete this partition. Continue until the partition on this device has been deleted.

   If INSTALL reports that it cannot delete the partition because another process has it locked, load MONITOR and look at the System Resources option to determine which NLM has locked the device. It may be *MONITOR.NLM*, so you will need to unload MONITOR and any other NLMs that have the partition locked. After you have recreated the partition and volume information, reload these NLMs.

6. Recreate the partition on the same logical drive.
7. Recreate and mount the volume.
8. Locate the recent backup media and restore the data to this server volume.

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Microsoft Windows NT

This section includes instructions for installing the initial driver for a new SMART-2DH Controller installation or upgrading the driver in an existing Windows NT server/SMART-2DH Controller system. If you use SmartStart to install Windows NT and drivers on a new server you do not need to make the Support Software Diskette (SSD) utility diskettes and can skip this section.

NOTE: Windows NT supports using the Compaq Array Configuration Utility to reconfigure your drive arrays online. However, the first use of the Array Configuration Utility on a Windows NT server must be offline to initially set up at least one array. After that, the utility can be used online to change the array configuration.

Materials Needed

You will need the following items to manually install the SMART-2DH Controller Windows NT driver on your server:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Array Controller Option Kit)
- Blank diskettes
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating the Windows NT SSD Diskettes

The Windows NT driver for the SMART-2DH Controller is located on the Compaq SmartStart and Support Software CD that was supplied in the SMART-2DH Controller Option Kit. To access to the driver you will first need to create the Windows NT SSD diskettes. These diskettes contain the latest operating system software, drivers, and support documentation for all Compaq equipment supported by Windows NT. To create the diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.

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2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Compaq Support Software for Windows NT.
5. Follow the instructions on the screen to create the Windows NT SSD diskettes.

Additional Information

Included on the Windows NT SSD diskettes is an *NTREADME.HLP* WinHelp file that contains the latest information about Windows NT, including the driver installation procedure. We encourage you to review this information and, where different from the instructions shown here, use the instructions provided in *NTREADME.HLP* on the Compaq SmartStart and Support Software CD (via the Windows NT SSD diskettes) that was supplied with your SMART-2DH Controller.

To read the NTREADME.HLP WinHelp file you will need a server running Windows NT or a PC running Windows:

1. Place the Windows NT SSD diskettes, one at a time, in the diskette drive.
2. Open a Command Prompt, make A: the current drive and type:

   ```
   readme.bat
   ```

   or

   From the File pull-down menu in Windows Program Manager, select Run and enter:

   ```
   A:\readme.bat
   ```

3. Select the help topic(s) to read or print. Important readme files are:
   - Compaq SSD for Windows NT Installation Methods
   - Using the Compaq SSD for Windows NT Setup Program

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- Windows NT Device Driver Specifics
- Compaq SCSI Controller Support
- Compaq Drive Array Support
- Installing the Compaq Drive Array Driver during Windows NT Installation
- Installing the Compaq Drive Array Driver after Windows NT Installation
- Updating the Compaq Drive Array Driver
- Removing the Compaq Drive Array Driver

Installation Procedures

Device drivers may be installed in a Windows NT server using:

- The Windows NT SSD Setup program installation method
- The standard Windows NT device driver installation methods

Although both are outlined in this chapter, we recommend the Windows NT SSD Setup program installation method.

Windows NT SSD Setup Program Installation Method

The Windows NT SSD Setup program installation method refers to device drivers that can be installed via the Setup program located on the Windows NT Support Software Diskettes. The Setup program provides a unified approach to device driver installation under Windows NT. The program identifies hardware components installed in the machine and suggests device drivers needing installation.

Use the following steps to run the Windows NT SSD Setup program:

1. Start Windows NT 3.51 or NT 4.0 and log into an account with administrative privileges.
2. Insert the Windows NT Support Software Diskettes, one at a time, into the diskette drive.

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3. From the Program Manager, select File → Run.
4. Enter the following:

```
A:\setup
```


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5. A list of drivers that can be installed on your server will appear. The highlighted drivers represent detected systems that will be installed by default. If you have previously installed the SMART-2DH Controller board in this server the Compaq SCSI Controllers Support - Install/Remove option will be highlighted.

   If you have not previously installed the SMART-2DH Controller board in this server you can still install the SMART-2DH Controller driver. The driver will appear on the list but will not be highlighted. Highlight the driver.

6. After highlighting all the drivers you wish to install, select Continue. Setup will install the selected drivers or prompt you for more information to install, remove, or update a driver.
7. Select Continue. In the SCSI Adapter Setup window, select Add. A Setup dialog box ask you to confirm the addition of a SCSI controller (adapter). Select OK.
8. Scroll through the Adapter list and select Other.
9. When prompted for the path to the SCSI Adapter files, enter:

   ```
   A:\scsi\array
   ```

   Select Continue.

10. Select Compaq Drive Array from the list of drivers to install. Select OK.
11. After the driver has been copied to the system, Setup will return to the SCSI Adapter Setup dialog box. Compaq Drive Array should appear in the list of installed SCSI controllers. Select Close.
12. Exit the program.
13. Remove the Windows NT SSD diskette, shut down Windows NT, and reboot the server to load the driver.

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Standard Windows NT Device Driver Installation Methods

Standard Windows NT device driver installation methods include different ways to install different device drivers on a Windows NT system. Some device drivers are installed during initial Windows NT installation. Others can be installed through a number of different programs: the Windows NT Setup program, the **Network** icon in the Windows Control Panel, or the **Drivers** icon in the Windows Control Panel.

Installing the SMART-2DH Controller Driver during Windows NT Installation

This section describes how to install the driver using the Windows NT Support Software Diskette utility during the initial installation of Windows NT 3.51 or NT 4.0. To install the driver after Windows NT has already been installed, see the section, "Installing the SMART-2DH Controller Driver after Windows NT Installation."

1. Begin the Windows NT 3.51 or NT 4.0 installation process.
2. When prompted to do either an Express or a Custom installation, select Custom.
3. When prompted to let Setup detect mass storage devices or to manually select them, press **S** to skip detection.
4. At the next screen, press **S** to specify additional SCSI controllers.
5. From the displayed list, highlight Other (Requires disk provided by a hardware manufacturer) by clicking on that line and press **Enter**.
6. As prompted, insert the Windows NT SSD diskettes, and press **Enter**.
7. Highlight Compaq Drive Array in the list of displayed controllers and press **Enter**.
8. After the driver has been loaded into memory, the Setup program will return to the screen displayed in step 4. Compaq Drive Array should now appear in the list of recognized mass storage devices. If it is necessary to install additional device support, repeat steps 4-8. Otherwise, continue with step 9.
9. Press **Enter** and continue installation of Windows NT.

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10. Later during Windows NT installation, reinsert the Windows NT SSD diskettes when prompted. The Setup program will copies the drivers to the system.
11. Finish installing Windows NT.

Installing the Compaq SMART-2DH Controller Driver after Windows NT Installation

Execute the Setup program in the root directory of the Windows NT Support Software Diskette utility to install or update the driver. This installation program will copy the appropriate driver and configure the system to use this driver.

1. Start Windows NT 3.51 or NT 4.0 and log in to an account with administrative privileges.
2. Insert the Windows NT SSD diskettes, one at a time, into the diskette drive.
3. From the Program Manager, select File → Run.
4. Enter the following:

```
A:\setup
```

5. The Setup program presents a list of drivers that can be installed. Select Compaq SCSI Controllers Support - Install/Remove.
6. Select Continue. In the SCSI Adapter Setup window, select Add. A Setup dialog box will be displayed asking you to confirm the addition of a SCSI controller (adapter). Select OK.
7. Scroll through the Adapter list and select Other.
8. When prompted for the path to the SCSI Adapter files, enter:

```
A:\scsi\array
```

   Select Continue.

9. Select Compaq Drive Array from the list of drivers to install. Select OK.

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10. After the driver has been copied to the system, Setup will return to the SCSI Adapter Setup dialog box. Compaq Drive Array should appear in the list of installed SCSI controllers. Select Close.
11. Exit the program.
12. Remove the Windows NT SSD diskette from the drive, shut down Windows NT, and reboot the server to load the driver.

Updating the SMART-2DH Controller Driver

Updating the SMART-2DH Controller driver is a two-step process: removing the driver, then re-adding the driver. With the new Compaq Support Software Diskette for Windows NT Setup program, you no longer have to perform the Remove/Add steps. You can simply update the driver by following these steps:

1. Start Windows NT and log in to an account with administrative privileges.
2. Insert the Windows SSD diskette (Diskette #1) into the diskette drive.
3. Start Setup by entering

   ```
   A:\setup
   ```

   where A: is the letter of the diskette drive.
4. Select Custom Setup.

   NOTE: The Compaq Array Driver will only be displayed in the Custom Setup menu if the Array driver is detected. It will only be displayed in the Express Setup menu if the Array driver is detected **and** not installed or not current.
5. Select the Mass Storage tabbed panel on the Custom Installation screen.
6. Select Compaq Drive Array; then, choose the Update button.

   Next, the Setup program updates the driver on your system from the Windows NT SSD diskettes.

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7. Select Close and exit the Setup program or select other tabbed sections to install/update/remove other software components.
8. Remove the Windows NT SSD diskette, shut down Windows NT, and reboot the system to load the driver.

Removing the SMART-2DH Controller Driver

IMPORTANT: **DO NOT** remove this driver if the system is booting from a device attached to a SMART-2DH Array Controller, you will get a dialog box stating, *The selected controller is marked as a boot device. Removing it may cause the system not to boot.*

1. Start Windows NT and log in to an account with administrative privileges.
2. Insert the Windows SSD diskette (Diskette #1) into the diskette drive.
3. Start Setup by entering

```
A:\setup
```

   where A: is the letter of the diskette drive.

4. Select Custom Setup.

   NOTE: The Compaq Array Driver will only be displayed in the Custom Setup menu if the Array driver is detected. It will only be displayed in the Express Setup menu if the Array driver is detected **and** not installed or not current.

5. Select the Mass Storage tabbed panel on the Custom Installation screen.
6. Select Compaq Drive Array; then, choose the Remove button.

   After the driver has been removed from your system, Setup returns to the Custom Installation window.

7. Select Close and exit the Setup program or select other tabbed sections to install/update/remove other software components.
8. Remove the Windows SSD diskette, shut down Windows NT, and reboot the system to load the driver.

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Updating the Compaq Insight Manager Agents

If you are using Compaq Insight Manager, you will need to update the Insight Agents for this monitoring utility for support of the new SMART-2DH Controller.

If you used SmartStart 3.40 or later to install the operating system on a new SMART-2DH Controller installation or upgrade your driver in an existing installation the agents were automatically updated for you by SmartStart, you will not have to manually update the agents.

If you did not use SmartStart 3.40 or later as part of your SMART-2DH Controller installation, you must manually update the Insight Agents. The correct agents can be obtained from your local Compaq Reseller or Authorized Compaq Service Provider. Refer to the documentation included with Compaq Insight Manager for the correct procedure for updating agents.

Installation of the SMART-2DH Array Controller is now complete. Reboot the server to begin using the array controller.

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SCO OpenServer 5

This section includes instructions for getting the latest driver and support information for installing the driver. If you use SmartStart to install SCO OpenServer 5 and drivers, you can skip this section and do not need to create the Extended Feature Supplement (EFS) diskettes.

If your system has an older SCO operating system or if you are setting up a new system with SCO OpenServer 5, we encourage you to use SmartStart to upgrade your operating system. SmartStart is supplied with the server or may be obtained from your local Compaq Reseller or Authorized Compaq Service Provider.

Getting the Driver and Installation Information

The latest drivers and support files for SCO OpenServer 5 and information about installing the driver are on the Compaq SmartStart and Support Software CD supplied with the SMART-2DH Array Controller Option Kit. To access these files you will need to create a set of Compaq EFS for OpenServer 5 diskettes from the Compaq SmartStart and Support Software CD.

Materials Needed

You will need the following items to create a set of Compaq EFS for OpenServer 5 diskettes:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Array Controller Option Kit)
- Blank diskettes
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Array Controller.

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Creating the EFS Diskettes

To create the EFS for SCO OpenServer 5 diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select:
   Compaq SCO OpenServer 5.0 EFS (for SCO OpenServer 5)
5. Follow the instructions on the screen to create and label the diskettes.
6. At the SCO Products screen again, select SCO Installation Notes for Compaq Servers.
7. Follow the instructions on the screen to create and label the diskettes.

Accessing the Information

Driver installation procedures for SCO OpenServer 5 from Compaq and SCO OpenServer 5 (non-Compaq) are different. Choose the correct procedure below.

Servers Running Compaq SCO OpenServer 5

To access the driver installation information for systems running SCO OpenServer 5 from Compaq:

1. Place the diskette labeled SCO Installation Notes for Compaq Servers in the diskette drive of a server or PC capable of reading a DOS text file.
2. Use a text editor or other DOS utility to read the INSTALL.TXT file on the diskette.
3. Follow the instructions in this file to install the SMART-2DH Controller driver in a server running SCO OpenServer 5 from Compaq.

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Servers Running Non-Compaq SCO OpenServer 5

To access the driver installation information for systems running non-Compaq SCO OpenServer 5:

1. Place the diskette labeled Documentation Diskette in the diskette drive of a server or PC.
2. Reboot the system.
3. Select the file named INSTALL.TXT to view (**Enter**) or print (**F7**).
4. Follow the instructions in this file to install the SMART-2DH Controller driver in a server running non-Compaq version of SCO OpenServer 5.

Updating the Compaq Insight Manager Agents

If you are using Compaq Insight Manager, you will need to update the Insight Agents for this monitoring utility for support of the new SMART-2DH Array Controller.

If you used SmartStart 3.40 or later to install the operating system on a new SMART-2DH Controller installation or upgrade your driver in an existing installation the agents were automatically updated for you by SmartStart, you will not have to manually update the agents.

The agents included in SmartStart 3.40 provide the same Insight Manager support as for the SMART Controller and includes support for SMART-2DH only. The agents in SmartStart versions later than 3.40 will provide full Insight Manager support for the SMART-2DH Controller.

If you did not use SmartStart 3.40 or later as part of your SMART-2DH Controller installation you must manually update the Insight Agents. The correct agents can be obtained from your local Compaq Reseller or Authorized Compaq Service Provider. Refer to the documentation included with Compaq Insight Manager for the correct procedure for updating agents.

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Installation of the Compaq SMART-2DH Array Controller is now complete. Reboot the server to begin using the array controller.

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SCO UnixWare 2.1 or Later

The instructions in this section describe where you can find the latest driver and support information necessary to install the initial driver for a new SMART-2DH Array Controller installation or to upgrade the driver in an existing UnixWare server/SMART-2DH Controller system. If you use SmartStart to install UnixWare and drivers on a new server, or to upgrade an existing server, you can skip this section and you do not need to create the EFS diskettes.

Getting the Driver and Installation Information

The latest drivers and support files for SCO UnixWare and information about installing the driver are located on the Compaq SmartStart and Support Software CD supplied with the SMART-2DH Controller Option Kit. To access these files you will need to create a set of Compaq EFS for SCO UnixWare 2.1 diskettes from the Compaq SmartStart and Support Software CD.

Materials Needed

You will need the following items to create a set of Compaq EFS for SCO UnixWare 2.1 diskettes:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Controller Option Kit)
- Blank diskettes
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating the EFS Diskettes

To create the Compaq EFS for SCO UnixWare 2.1 diskettes:

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1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Compaq SCO OpenServer 5 EFS.
5. Follow the instructions on the screen to create and label diskettes.

Accessing the Information

To access the driver installation information:

1. Place the diskette labeled *Documentation Diskette* in the diskette drive of a server or PC.
2. Reboot the system.
3. Select the file named *README.HBA* to view or print.
4. Follow the instructions in this file to install the SMART-2DH Controller driver in an existing UnixWare server.

Updating the Compaq Insight Manager Agents

If you are using Compaq Insight Manager you will need to update the Insight Agents for this monitoring utility for support of the new SMART-2DH Controller.

If you used SmartStart 3.40 or later to install the operating system on a new SMART-2DH Controller installation or upgrade your driver in an existing installation, the agents were automatically updated for you by SmartStart; you will not have to manually update the agents.

The agents included in SmartStart 3.40 provide the same Insight Manager support as for the SMART Controller and include support for SMART-2DH only. The agents in SmartStart 3.40 or later provide full Insight Manager support for the SMART-2DH Controller.

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If you did not use SmartStart 3.40 or later as part of your SMART-2DH Controller installation, you must manually update the Insight Agents. The correct agents can be obtained from your local Compaq Reseller or Authorized Compaq Service Provider. Refer to the documentation included with Compaq Insight Manager for the correct procedure for updating agents.

Installation of the Compaq SMART-2DH Array Controller is now complete. Reboot the server to begin using the array controller.

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IBM OS/2

The instructions in this section may be used to install the initial driver for a new SMART-2DH Controller installation or to upgrade the driver in an existing OS/2 server/SMART-2DH Controller system. If you use SmartStart to install OS/2 and drivers on a new server you do not need to create the OS/2 SSD diskette and you can skip this section.

Materials Needed

You will need the following items to manually install the SMART-2DH Controller OS/2 driver on your server:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Controller Option Kit)
- One blank diskette
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating an SSD Diskette

The OS/2 driver for the SMART-2DH Controller is located on the Compaq SmartStart and Support Software CD that was supplied in the SMART-2DH Array Controller Option Kit. To gain access to the driver you will first need to create the OS/2 SSD diskette. This diskette contains the latest operating system software, drivers, and supporting documentation for all Compaq equipment supported by OS/2. To create this diskette:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen , select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Compaq OS/2 2.x Support Software.
5. Follow the instructions on the screen to create the OS/2 SSD diskette.

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Additional Information

Readme files containing the latest information about OS/2, including the driver installation procedure, are included on the OS/2 SSD diskette. Locate and read this procedure. If the procedure differs from that shown here, use the one on the SSD diskette.

To read the Readme files you will need a server with a DOS partition or a PC running DOS or Windows:

1. Place the OS/2 SSD diskette in the floppy drive.
2. From the DOS prompt, type:

   ```
   A:\readme
   ```

   or

   From the File pull-down menu in Windows Program Manager, select Run and enter:

   ```
   A:\readme.com
   ```

3. Select the files to read or print. Some files that should be of particular interest are:
   - *README.1ST*
   - *WHATSNEW.RDM*
   - *ADDARRAY.RDM*
   - *HISTORY.RDM*

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Installing the Driver

To copy the driver file to the OS/2 directory on your boot drive:

1. Place the OS/2 SSD in the floppy drive.
2. From the OS/2 command prompt, type:

```
A:\addarray c:
```

   The CPQARRAY.ADD driver file will be copied to the *x*:\os2 directory (where *x* is the boot drive) and any existing driver will be renamed CPQARRAY.OLD. The *CONFIG.SYS* file will be updated to load this driver first on boot. This means that the first drive on this controller is the boot drive.

3. If you do not want to boot from a drive on this controller; for instance, if you wanted to boot from a drive attached to the integrated SCSI controller, you must manually change the *CONFIG.SYS* file before you reboot the server. Edit the *CONFIG.SYS* file to reorder the BASEDEV=CPQARRAY.ADD statement so that it appears after the BASEDEV statement corresponding to the boot driver.
4. Save the updated *CONFIG.SYS* file and exit the editor.
5. Perform a normal system shutdown and reboot the server to load the new driver.

Controller Ordering

There are two factors that determine controller ordering under IBM OS/2:

1. The order in which the ADD driver appears in the *CONFIG.SYS* file determines how each type of controller is ordered relative to other types of controllers.

   Each type of controller that a single ADD driver controls will be grouped together. The first ADD driver to appear in the *CONFIG.SYS* file will have its controllers ordered first, the second ADD driver will have its controllers ordered after the first driver, etc.

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The slot in which the controller is installed does not affect the loading order; only the order shown in *CONFIG.SYS* affects the order.

2. Each ADD driver developed by Compaq will order its controllers in ascending order based on the controller order assigned by the Compaq System Configuration Utility.

The following set of rules must be followed for the driver to function properly with other storage controllers configured in the system.

NOTE: These rules are NOT automatically enforced by the Compaq System Configuration Utility. Follow them carefully when configuring the system.

1. All Compaq array controllers should be in consecutive order as a group. If booting from a Compaq SMART-2DH Array Controller, the statement, *BASEDEV = CPQARRAY.ADD* must be present.
2. If a Compaq IAES Controller is the only other controller installed in the system, since it cannot be primary, the system must boot from the Compaq SMART-2DH Array Controller (controller order = First).

Partitioning

The following are limitations for OS/2 on any computer system:

- Any FAT partition cannot be larger than 2 GB (2048 MB) in size.
- It is recommended that you do not exceed 8 GB for an HPFS boot partition. If you exceed this size it would be possible for the OS/2 system files to end up beyond 8 GB on the disk and this would prevent the ROM from loading them at boot time.

OS/2 may allow the creation of partitions beyond these specified boundaries, but you should adhere to these limits to ensure proper functionality.

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Booting OS/2 from a SMART-2DH Array Controller Drive

This section describes additional information on booting a system from a Compaq SMART-2DH Array Controller.

The CPQARRAY.ADD driver must always be present when booting from a SMART-2DH Controller (the Compaq IAES is not a bootable device).

If a SMART-2DH Controller is the primary disk controller, edit the *CONFIG.SYS* file and make sure the "BASEDEV=CPQARRAY.ADD" entry in the file is the first BASEDEV entry present. This will guarantee that the CPQARRAY.ADD driver will be the first ADD driver loaded and thus cause OS/2 to assign the first hard drive on the first SMART-2DH Controller as the boot drive. For example:

```
BASEDEV=CPQARRAY.ADD

BASEDEV=CPQ53CX.ADD
```

If OS/2 will be booting from another controller, order the other controller first:

```
BASEDEV=AMSI02.ADD

BASEDEV=CPQARRAY.ADD
```


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Command Line Switches

In certain situations you may want to modify the standard behavior of the Compaq ADD driver. Several command line switches have been made available for this purpose. The syntax of the command line switches is:

1. /PERF:[memory blocks]

   This command line switch is a non-standard switch implemented for the CPQARRAY.ADD. It should be used to modify the performance characteristics of the driver when using a SMART-2DH Controller. Under heavy disk utilization this command switch will allow greater performance based on the number associated with the [memory blocks] parameter. The larger the [memory blocks] parameter the better the performance under heavy disk utilization. Be aware that when you increase this parameter, the CPQARRAY.ADD driver will use more memory.

   ```
   BASEDEV=CPQARRAY.ADD /PERF:[memory blocks]
   ```

   [memory blocks] A number in the range of 3 to 9 indicating the amount of memory blocks allocated per SMART-2DH Controller in the system. The driver runs at a default value of 5. To determine the amount of memory being used you can use this formula:

   Number of SMART-2DH Controllers * [memory blocks] * 64kb

   Example:

   ```
   BASEDEV=CPQARRAY.ADD /PERF 6
   ```

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2. /V

   The Verbose mode command line switch is a standard command line switch which causes the driver to print information to the screen when it loads. The driver will identify itself along with the current revision. Then information concerning the adapters and the drives attached to them will be provided. Adapter information includes IRQ, slot number, and controller order number. Drive information includes physical and logical drive count, and the geometry information for each logical drive.

   Example:

   ```
   BASEDEV=CPQARRAY.ADD /V
   ```

3. /A:[adapter index] [unit parameters]

   This is a standard command line switch which will cause the driver to modify its behavior towards adapters.

   [adapter index] The adapter index is a number used to identify a controller. The index is based on '0' for the lowest controller order number associated with the adapter controlled by this ADD. The index is incremented by one for each controller in the system as you move up the controller configuration order.

   Example: A system that has three adapters controlled by the CPQARRAY.ADD, with the lowest configured adapter being the secondary controller.

Controller Order	Adapter Index
2	0
3	1
5	2

   [unit parameters] This ADD only supports the /I parameter, to ignore a controller. The following unit parameter is available: /I

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Ignore the specified adapter; do not control the adapter with this driver. This parameter prevents the ADD driver from recognizing the specified adapter. Use this parameter when you intend to allow another driver to control a specific adapter.

IMPORTANT: Be careful not to ignore the primary controller or the boot controller; this would cause the system to be unable to boot.

Example: You are running intraNetWare on your OS/2 2.x system and you want an intraNetWare NLM to control adapter 2 instead of the ADD driver. The following statement would prevent the ADD driver from claiming adapter 2.

```
BASEDEV=CPQARRAY.ADD /A:2 /I
```

Important Information

The driver MUST be loaded by a BASEDEV= statement in the *CONFIG.SYS* file. This statement is automatically inserted by the ADDARRAY.CMD installation procedure.

Updating the Compaq Insight Manager Agents

If you are using Compaq Insight Manager you will also need to update the Insight Agents for this monitoring utility for support of the new SMART-2DH Controller.

If you used SmartStart 3.40 or later to install the operating system on a new SMART-2DH Controller installation or upgrade your driver in an existing installation the agents were automatically updated for you by SmartStart, you will not have to manually update the agents.

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If you did not use SmartStart 3.40 or later as part of your SMART-2DH Controller installation you must manually update the Insight Agents. The correct agents can be obtained from your local Compaq Reseller or Authorized Compaq Service Provider. Refer to the documentation included with Compaq Insight Manager for the correct procedure for updating agents.

Installation of the Compaq SMART-2DH Array Controller is now complete. Reboot the server to begin using the array controller.

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Banyan VINES 6.0 or Later

The instructions in this section can be used to install the initial driver for a new SMART-2DH Controller installation or to upgrade the driver in an existing Banyan VINES 6.x and 7.x Server/SMART-2DH Controller system.

Materials Needed

You will need the following items to manually install the Banyan VINES driver for the SMART-2DH Controller on your server:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Controller Option Kit)
- Blank diskettes
- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating the Peripheral Adapter Support Software Diskettes

The Banyan VINES 6.x and 7.x driver with installation procedures and other information for the SMART-2DH Controller is located on the Compaq SmartStart and Support Software CD supplied in the SMART-2DH Array Controller Option Kit. To access the driver you will first need to create the Peripheral Adapter Support Software for VINES 6.0 and 7.0 diskettes. These diskettes contain the latest drivers and supporting documentation for all Compaq equipment (except NICs) supported by Banyan VINES 6.0 and 7.0. To create diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Peripheral Adapter Support Software for VINES 6.0 and 7.0.

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5. Follow the instructions on the screen to create the diskettes.

Additional Information

The last Peripheral Adapter Support Software diskette is a bootable DOS documentation diskette. The *README.SSD* file on this diskette contains a short description of the drivers (a single Compaq driver supports the SMART-2 series of controllers) and includes a procedure for installing the SMART-2DH Controller driver. To access this file, follow the instructions on the diskette label.

Installing the Driver

To install the SMART-2DH Controller driver, follow the installation procedures specified in the *README.SSD* file.

Installation of the SMART-2DH Array Controller is now complete. Reboot the server to begin using the array controller.

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Microsoft Windows 95

When configuring the hardware using the System Configuration Utility, set these SMART-2DH Controller parameters:

- Set the Controller Order of **one** SMART-2DH Controller to *First* (a SMART-2DH Controller must be the primary disk controller under DOS).
- Set the Controller Order of all other SMART-2DH Controller boards (if any) consecutively beginning with *Second.*
- Set the Controller Order of other drive controller types (if any) higher than all SMART-2DH Controller boards.
- For best performance, set the Interrupt Selection for all SMART-2DH Controller boards to *Enabled.*

Getting the Driver and Installation Information

The instructions in this section can be used to retrieve the latest driver and information necessary to install the initial driver for a new SMART-2DH Array Controller installation or to upgrade the driver in an existing Windows 95 server/SMART-2DH Controller system.

The latest drivers and support files for Windows 95 as well as information about installing the driver is located on the Compaq SmartStart and Support Software CD supplied with the SMART-2DH Controller Option Kit. To access these files, you will need to create a set of Compaq Windows 95 diskettes from the Compaq SmartStart and Support Software CD.

Materials Needed

You will need these items to create a set of Compaq Windows 95 diskettes:

- Compaq SmartStart and Support Software CD (supplied in the SMART-2DH Controller Option Kit)
- Blank diskettes

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- Access to a server or workstation with a bootable CD-ROM drive. This may be the system in which you are installing the SMART-2DH Controller.

Creating the Windows 95 Diskettes

To create the diskettes:

1. Boot the server from the Compaq SmartStart and Support Software CD.
2. From the Compaq System Utilities screen, select Create Support Software.
3. From the Diskette Builder screen, select Create Support Software Diskettes from CD only.
4. Scroll down the list and select Compaq Support Software for Windows 95.
5. Follow the instructions on the screen to create and label diskettes.

Installing the SMART-2DH Array Controller with Windows 95

Use these basic steps to install a SMART-2DH Controller in a Windows 95 server to operate in either the SMART-2 Controller mode or the Interrupt 13h BIOS support mode.

SMART-2 Controller Mode

To install the SMART-2DH Controller in a Windows 95 environment using the SMART Controller mode, follow these steps:

1. Update your system firmware by running System ROMPaq.
2. Install the SMART-2DH Controller option board.
3. Configure the hardware by running the System Configuration Utility. Be sure to set these SMART-2DH Controller parameters:
   - Set the Controller Order. If the SMART-2DH Controller will be the primary disk controller set this parameter to *First*.

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- For best performance, set the Interrupt Selection for all SMART-2DH Controller boards to *Enabled*.

4. Configure your drive array with Array Configuration Utility. Be sure to select Windows 95 as the primary operating system.

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5. Install the driver:
   - Log in to Windows 95.
   - Select Add New Hardware.
   - Choose NO when prompted to search for hardware.
   - Select SCSI Controllers.
   - Select Have Disk button.
   - In the Install From Disk menu, enter the path to the array directory \WindowsDir\CPQSYS\ARRAY. The driver will be copied to the appropriate directory.

     For this step to work properly, the following steps must have been previously executed: (1) a copy of the Windows 95 diskettes has been made (2) the instructions in the README.1ST file have been followed, and (3) diskette files have been copied to the hard drive.
   - Reboot the server for the new settings to take affect.

NOTE: To install SMART-2DH Controller as a primary controller, you must have the additional *SMRT.SYS* driver in *CONFIG.SYS* before booting. Refer to the *README.TXT* file on the Windows 95 diskettes.

Interrupt 13h BIOS Support

Interrupt 13h BIOS support in the SMART-2DH Controller Option ROM provides support for up to eight logical drives total on multiple SMART-2DH controllers. Controllers can be SMART-2DH or SMART-2/P, or a combination of the two. To install the SMART-2DH Controller in a Windows 95 environment using the Interrupt 13h BIOS support mode, follow these steps:

1. Update your system firmware by running System ROMPaq.
2. Install the SMART-2DH Controller option board (see Chapters 3 - 7 for your system).
3. Configure the hardware by running the System Configuration Utility. Be sure to set these SMART-2DH Controller parameters:
   - Set the Controller Order of one SMART-2DH Controller to *First* (a SMART-2DH Controller must be the primary disk controller).

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- Set the Controller Order of all other SMART-2DH Controller boards (if any) consecutively, beginning with *Second*.
- Set the Controller Order of other drive controller types (if any) higher than all SMART-2DH Controller boards.
- Set the Option ROM to *Enabled* (SMART-2DH/E Controller only) for **one** SMART-2DH Controller only. This parameter is always enabled for SMART-2DH Controller boards and is not available for change.
- For best performance, set the Interrupt Selection for all SMART-2DH Controller boards to *Enabled*.

Configure your drive array with the Compaq Array Configuration Utility. Be sure to select Windows 95 as the primary operating system.

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Appendix A
Electrostatic Discharge

A discharge of static electricity from a finger or other conductor may damage printed circuit boards or other static-sensitive devices. This type of damage may reduce the life expectancy of the device.

Preventing Electrostatic Damage

To prevent electrostatic damage, observe the following precautions:

- Avoid hand contact by transporting and storing parts in static-safe containers.
- Keep electrostatic-sensitive parts in their containers until they arrive at static-free work stations.
- Place parts on a grounded surface before removing them from their container.
- Avoid touching pins, leads, or circuitry.
- Always be properly grounded when touching a static-sensitive component or assembly.

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Grounding Methods

There are several methods for grounding. Use one or more of the following measures when handling or installing electrostatic-sensitive parts:

- Use a wrist strap connected by a ground cord to a grounded workstation or the computer chassis. Wrist straps are flexible straps with a minimum of 1 megohm +/- 10 percent resistance in the ground cords.
- Use heel straps, toe straps, or bootstraps at standing workstations. Wear the straps on both feet when standing on conductive floors or dissipating
floor mats.
- Use conductive field service tools.
- Use a portable field service kit with a folding static-dissipating work mat.

If you do not have any of the suggested equipment for proper grounding, have an Authorized Compaq Service Provider install the part.

NOTE: For additional information on static electricity, or assistance with the installation of this product, contact your Authorized Compaq Service Provider or refer to the Maintenance and Service Guide.

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Appendix B
Specifications

This appendix provides physical, operating, and performance specifications for the SMART-2DH Controller.

SMART-2DH Controller

Table B-1
SMART-2DH Controller Specifications

Dimensions	English	International
Height	3.9 in	9.9 cm
Length	13.75 in	34.9 cm
Thickness (including Array Accelerator)	0.60 in	1.5 cm
Total Weight (including Array Accelerator)	N/A	N/A
Temperature Range		
Operating	50° to 95°F	10° to 35°C
Shipping	-22° to 140°F	-30° to 60°C
Relative Humidity (non condensing)		
Operating	20% to 80%	20% to 80%
Non-operating	5% to 90%	5% to 90%
Power Required		
+5V	2.6 amps	
+12V	20 ma	
-12V	20 ma	
Heat Dissipated (maximum)	13.5 watts	
SCSI Channels	2	
Drives Supported (maximum, internal and external)	14	
Data Transfer Method	32-Bit Bus Master	
SCSI Bus Transfer Rate (maximum)	40 MB/sec (20 Mhz) per channel	
PCI Bus Transfer Rate (maximum)	132 MB/sec	
SCSI Bus Termination	Required	

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SCSI Port Connectors (internal and external)	68-pin Wide-Ultra SCSI/Fast-Wide SCSI-2 (Wide SCSI)

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Wide SCSI Connector Pin Assignments

Figure B-1 and Table B-3 identifies the pin assignments of the 68-pin internal and external Wide SCSI connectors.

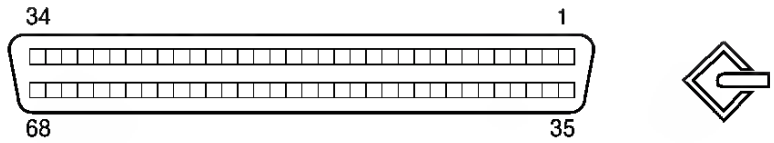

Figure B-1. **Wide SCSI Connector**

Table B-2
68-Pin Wide SCSI Connector Pin Assignments

Pin	Signal	Pin	Signal
1	N/C	35	DB12*
2	Ground	36	DB13*
3	Ground	37	DB14*
4	Ground	38	DB15*
5	Ground	39	DB Parity 2*
6	Ground	40	DB0*
7	Ground	41	DB1*
8	Ground	42	DB2*
9	Ground	43	DB3*
10	Ground	44	DB4*
11	Ground	45	DB5*
12	Ground	46	DB6*

Continued

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68-Pin Wide SCSI Connector Pin Assignments *Continued*

Pin	Signal	Pin	Signal
13	Ground	47	OB7*
14	Ground	48	DB Parity*
15	Ground	49	Ground
16	Ground	50	Ground
17	TERMPWR	51	TERMPWR
18	TERMPWR	52	TERMPWR
19	N/C	53	Int_Out*
20	Ground	54	Ground
21	Ground	55	ATN*
22	Ground	56	Ground
23	Ground	57	BSY*
24	Ground	58	ACK*
25	Ground	59	RESET*
26	Ground	60	MSG*
27	Ground	61	SEL*
28	Ground	62	C/D*
29	Ground	63	REQ*
30	Ground	64	I/O*
31	Ground	65	DB8*
32	Ground	66	DB9*
33	Ground	67	DB10*
34	Ground	68	DB11*

* - Active low signals

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Appendix C
Things You Should Know

Option Kit Contents

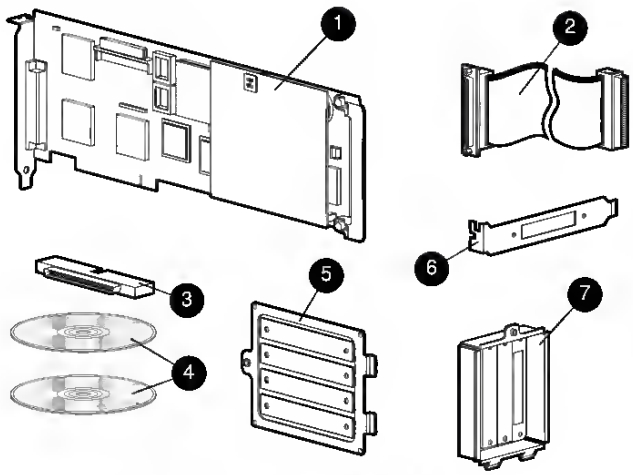

Figure C-1. **SMART-2DH Controller Option Kit**

SMART-2DH Controller Option Kit Contents

❶ SMART-2DH Controller
(PN 295244-001)
Option Kit PN 295242-B21

❷ Internal/External SCSI cable

(P/N 199595-002)

❸ SCSI Cable Adapter

❹ Compaq SmartStart and Support Software CD

and Storage and Options Library CD

❺ Flat Connector Panel for
Rack-Mountable Servers

❻ Option Slot Connector Panel

❼ Connector Panel

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SCSI Termination

All SCSI buses require termination on both ends of the bus to prevent signal degradation. The SMART-2DH Controller supplies the termination on the origination end of the SCSI bus. All internal SCSI cabling recommended for Compaq servers provides the necessary termination for the opposite end of the bus. Therefore, individual SCSI drives in Compaq servers should not contain bus termination.

External SCSI devices must also provide termination for the SCSI bus. This is supplied in Compaq external storage systems such as the ProLiant Storage System or SCSI Storage Expander. Therefore, individual SCSI drives in Compaq storage systems should not contain bus termination.

SCSI IDs

The SMART-2DH Controller contains two SCSI buses (ports), each of which supports up to seven drives. The internal and external connectors reside on separate SCSI buses; peripherals attached to either connector must have a unique SCSI ID in the range of 0 to 6. SCSI IDs on all peripherals are set manually with switches or jumpers on the device itself, or set automatically on Compaq products that support hot-pluggable drives. The SCSI ID determines the device's priority when attempting to use the SCSI bus. The highest priority, SCSI ID 7, is reserved for use by the controller. SCSI IDs 8 to 15 are not currently supported by the SMART-2DH Controller.

SCSI Cabling

The cables available from Compaq that connect your SMART-2DH Controller option board to SCSI drives in any Compaq server or external SCSI product can be found:

- in the SMART-2DH Array Controller Installation Guide, or
- at www.compaq.com/products/servers/*servername*/scsicableguide.html, or
- in the Setup and Installation Guide, or Reference Guide, that accompanied your server.

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Use this information to determine your cabling requirements and order the cable option kit number from your local Compaq Reseller or Authorized Compaq Service Provider.

SCSI Cable Connectors

To help identify the SCSI cables required for SMART-2DH Controller installation in the various configurations of Compaq servers, refer to the illustration below. Keep in mind these characteristics of SCSI cables:

- External SCSI cables have a round wire with securable connectors.
- Internal SCSI cables have a flat ribbon wire with push-on connectors.
- Compaq SCSI cables are keyed so they cannot be installed incorrectly.
- Fast-Wide SCSI-2 and Wide-Ultra SCSI (Wide SCSI) internal ribbon cables are physically narrower than Fast-SCSI-2 (standard SCSI) cables.

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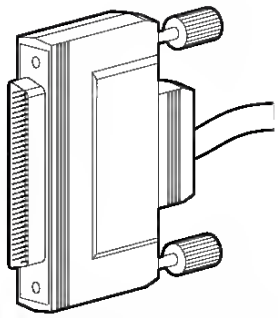
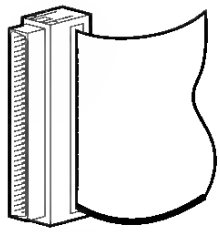
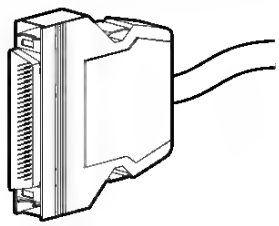


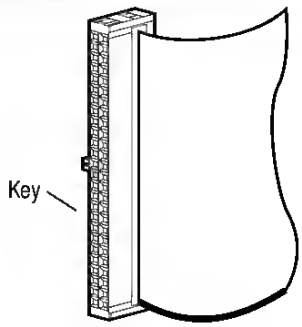
External Wide-Ultra SCSI/Fast-Wide SCSI-2 (Wide SCSI) 68-Pin



Internal Wide-Ultra SCSI/Fast-Wide SCSI-2 (Wide SCSI) 68-Pin



External Fast-SCSI-2 (Standard SCSI) 50-Pin



Internal Fast-SCSI-2 (Standard SCSI) 50-Pin

Figure C-2. **Identifying SCSI Cable Connectors**

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Migrating to/from Other SMART Array Controllers

The table below indicates what actions, if any, are required when migrating from one array controller type to another within the SMART family of controllers.

NOTE: It is recommended that any time you move drive arrays or change your configuration you should back up data.

Table C-1
Migrating to/from other Controllers

To		SMART-1	SMART-2/E	SMART-2/P	SMART-2SL	SMART-2DH
From	SMART-1	X	X	X	X	X
	SMART-2/E	BU/Restore	X	X	X	X
	SMART-2/P	BU/Restore	X	X	X	X
	SMART-2SL	BU/Restore	FW Upgrade	FW Upgrade	X	X
	SMART-2DH	BU/Restore	FW Upgrade	FW Upgrade	X	X

Legend:

X: No action required. Recommended back up of data prior to migrating to another controller.

BU/Restore: Mandatory data back up and restore to prevent data loss.

FW Upgrade: Upgrade of SMART-2/E or /P Controller FW to v1.90 or later is recommended to allow connection of drive arrays to either SCSI bus. However, if a logical volume spans both ports, the drives must be connected to the same port as they were with the original controller. In all cases drives within a volume must keep their same relative order.

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Appendix D
Understanding Drive Arrays

This chapter provides explanations of drive array concepts, data protection methods including fault tolerance options, and data reliability features of the SMART-2DH Array Controller. Before you configure your SMART-2DH Controller, review the following general information so that you will be familiar with the terms and concepts required for configuration.

What is a Drive Array?

A drive array is simply a collection of hard disk drives or *physical drives* that are grouped together to create an *array* of physical drives. An array is made up of one or more subsets called *logical drives* (sometimes called logical volumes), which are spread across all physical drives in the array. Operating systems view logical drives as a single, contiguous storage space, although it is made up of parts of several physical drives.

The generic drive array illustrated in Figure D-1 consists of two logical drives spread across three physical drives. Figures D-2 through D-4 illustrate other drive array configurations.

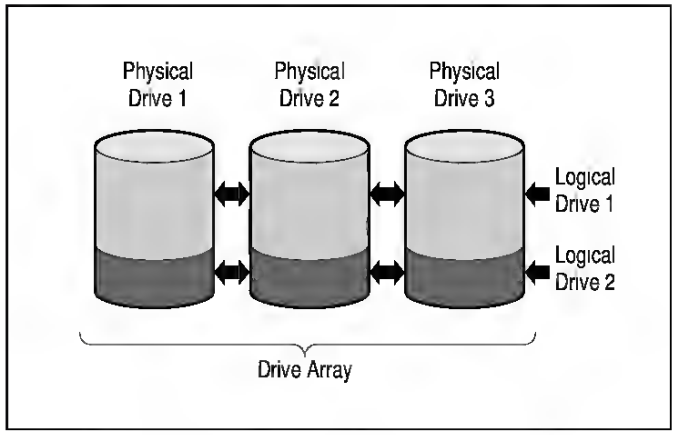

Figure D-1. **Drive array with two logical drives**

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A drive array may also consist of a single logical drive, as illustrated in Figure D-2.

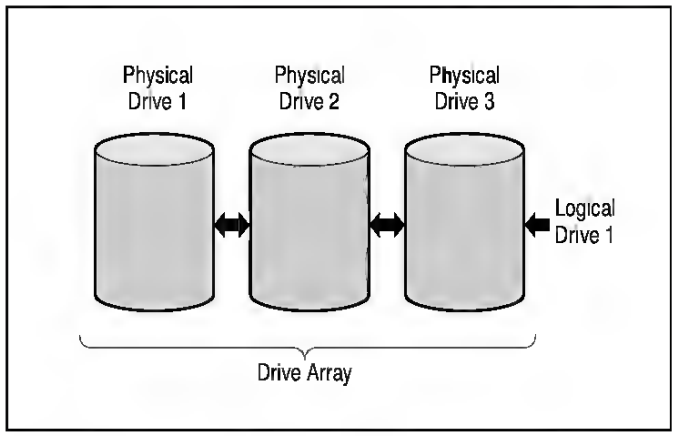

Figure D-2. **Drive array with one logical drive**

Figure D-3 illustrates a larger array with two logical drives across six physical drives.

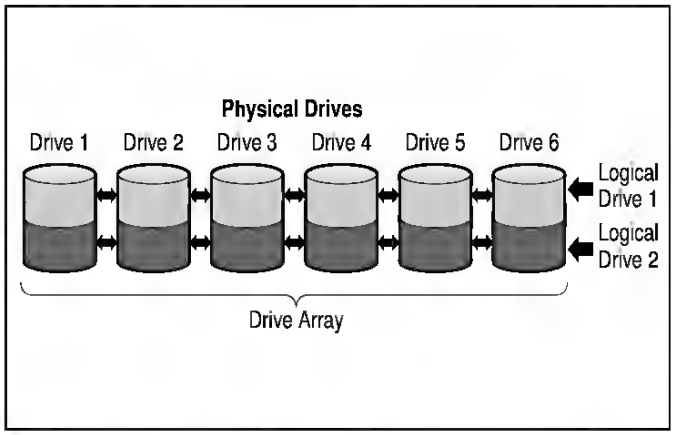

Figure D-3. **Drive array with six physical drives and two logical drives**

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The same physical drives may also be arranged into separate arrays, as illustrated in Figure D-4. Both arrays may be handled by the same controller.

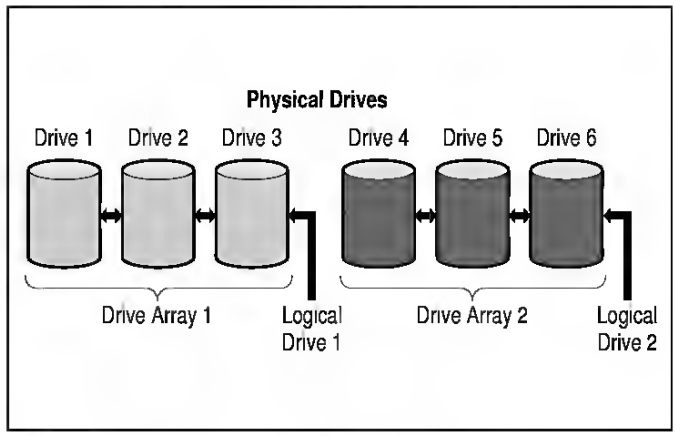

Figure D-4 **Two drive arrays with six physical drives**

Drive Arrays

Drive arrays on the SMART-2DH Controller have several important attributes:

- A single array cannot span more than one SMART-2DH Controller.
- A single SMART-2DH Controller can control multiple arrays.
- Arrays must have at least one and may have up to 14 physical drives.
- Arrays consist of at least one and may have up to 32 logical drives (maximum 32 logical drives per controller).
- For maximum space efficiency, all drives in a single array should be the same capacity.

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Logical Drives

The concept of logical drives is an important one. A logical drive is storage space that is distributed across *all* physical drives in an array (except for online spares). (See Figure D-3.) Distributing the storage space provides these advantages:

- Data can be accessed on all the physical drives at once, resulting in much higher performance data storage and retrieval.
- Fault-tolerance methods may be used to protect your data against hardware failures.

An array can consist of several logical drives, each spanning all of the physical drives in the array. It is important to note that the part of any one logical drive residing on each physical drive is the same size. This means that for maximum space efficiency, all physical drives in each array should also be the same size.

Logical drives have these important attributes:

- There must be at least one and up to 32 logical drives in an array (maximum 32 logical drives per controller).
- Logical drives in an array may be different sizes.
- Logical drives in an array may use different fault tolerance methods (RAID levels).
- The portion of a logical drive on each physical drive is the same size.

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Drive Array Benefits

Using drive arrays with the SMART-2DH Array Controller has several important benefits:

- Data Protection
- Performance Enhancement
- Capacity Changes
- Data Reliability

Data Protection

The SMART-2DH Controller provides several options to produce data redundancy for a more reliable system including distributing data, fault tolerance methods, assigning online spares, and rebuilding data.

Fault Tolerance (RAID) Options

During configuration, you will need to make RAID (Redundant Arrays of Inexpensive Disks) level choices. RAID is a term used for an array technology that provides data redundancy to increase system reliability and performance.

There are several RAID levels ranging from RAID-5 to RAID-0. The SMART-2DH Controller provides the following levels of RAID:

- RAID 5 - distributed data guarding
- RAID 4 - data guarding
- RAID 1 - drive mirroring
- RAID 0 - no fault tolerance (data striping only)

The fault tolerance method you choose affects the amount of available disk storage capacity and performance of your drive array. Table D-1 lists the supported RAID levels and illustrates how the fault tolerance method you select affects the performance and capacity.

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Table D-1
RAID Level Characteristics

	Distributed Data Guarding (RAID 5)	Data Guarding (RAID 4)	Mirroring (RAID 1)	No Fault Tolerance (RAID 0)
Usable Disk Space*	67% to 93%	67% to 93%	50%	100%
Disk Space Formula (n = no. of drives)	(n-1)/n	(n-1)/n	n/2	n
Parity and Data Redundancy	Parity distributed over each drive	Dedicated parity drive	Duplicate data	None
Minimum Number of Drives	3	3	2	1
Comments	Tolerant of single drive failures. Higher performance than RAID 4. Uses the least amount of storage capacity for fault tolerance.	Tolerant of single drive failures. Like RAID 5, uses the least amount of storage capacity for fault tolerance.	Tolerant of multiple, simultaneous drive failures. Higher performance than RAID 4 or 5. Uses the most storage capacity for fault tolerance. Requires an even number of drives.	Best performance, but data is lost if any drive in the logical drive fails. Uses no storage space for fault tolerance.

* All drives are the same capacity

If you require a fault-tolerant system for critical data, Compaq recommends using RAID 5 for maximum storage space efficiency or RAID 1 if I/O performance is more important.

If you will be storing non-critical data and space and performance are both important, RAID 0 offers the best of both parameters. However, RAID 0 has no data protection and you will have to rely on backups in case of hardware failure.

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Distributed Data Guarding (RAID 5)

Distributed data guarding, also called RAID 5, stores parity data across all the drives in the array. Spreading the parity across all the drives allows more simultaneous read operations and higher performance than data guarding (RAID 4). If a drive fails, the controller uses the parity data and the data on the remaining drives to reconstruct data from the failed drive. This allows the system to continue operating with a slightly reduced performance until you replace the failed drive.

Distributed data guarding requires an array with a minimum of three physical drives and allows a maximum of 14 drives. Therefore, in an array containing three physical drives, distributed data guarding uses only 33 percent of the total logical drive storage capacity for fault tolerance, while a 14-drive configuration uses only 7 percent.

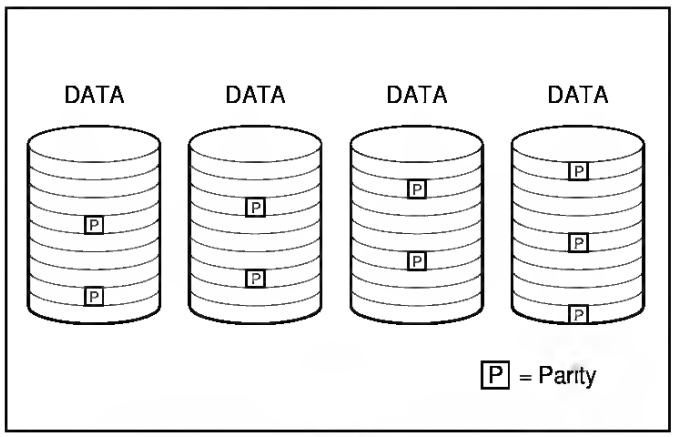

Figure D-5. **Distributed Data Guarding distributes the redundant data [P] throughout the physical drives**

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Data Guarding (RAID 4)

Data guarding, also called RAID 4, assures data reliability while using only a small percentage of the logical drive storage capacity. A designated, single drive contains parity data. If a drive fails, the controller uses the data on the parity drive and the data on the remaining drives to reconstruct data from the failed drive. This allows the system to continue operating with slightly reduced performance until you replace the failed drive.

Data guarding requires a minimum of three drives (two data drives and one parity drive) in an array and allows a maximum of 14 drives (13 data drives and one parity drive). For example, in an array containing three physical drives, data guarding uses only 33 percent of the total logical drive storage capacity for fault tolerance. A 14-drive configuration (13 data drives, one parity drive) uses only 7 percent.

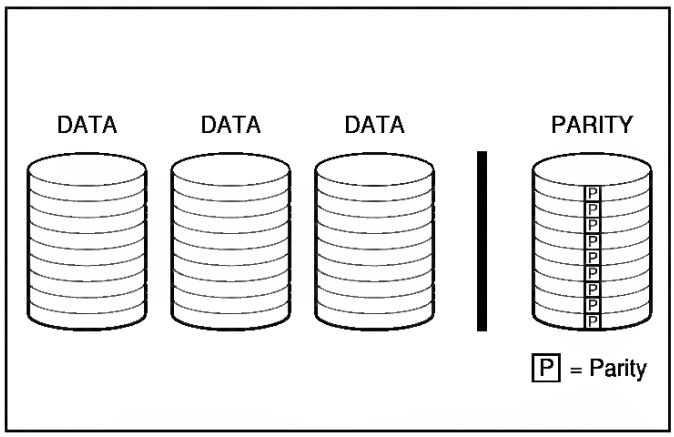

Figure D-6. **Data Guarding Stores redundant data [P] on a separate drive**

The SMART-2DH Array Controller supports RAID 4 for backward compatibility. Because RAID 5 provides the same benefits with higher performance, Compaq recommends using RAID 5 instead of RAID 4.

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Drive Mirroring (RAID 1)

Drive mirroring, also called RAID 1, is the highest performance fault tolerance method. RAID 1 is the only option offering fault tolerance protection if only two drives are installed or selected for an array. Drive mirroring creates fault tolerance by storing two sets of duplicate data on a pair of disk drives. Therefore, RAID 1 is the most expensive fault tolerance method because 50 percent of the drive capacity is used to store the redundant data. RAID 1 always requires an even number of drives. To improve performance in configurations with more than two drives, the data is striped across the drives. This is also referred to as RAID 1+0 or RAID 10.

If a drive fails, the mirror drive provides a backup copy of the files and normal system operations are not interrupted. The mirroring feature requires a minimum of two drives and, in a multiple drive configuration (four or more drives), mirroring can withstand multiple simultaneous drive failures as long as the failed drives are not mirrored to each other.

IMPORTANT: If two drives being mirrored to each other fail, the volume is failed and data loss may occur.

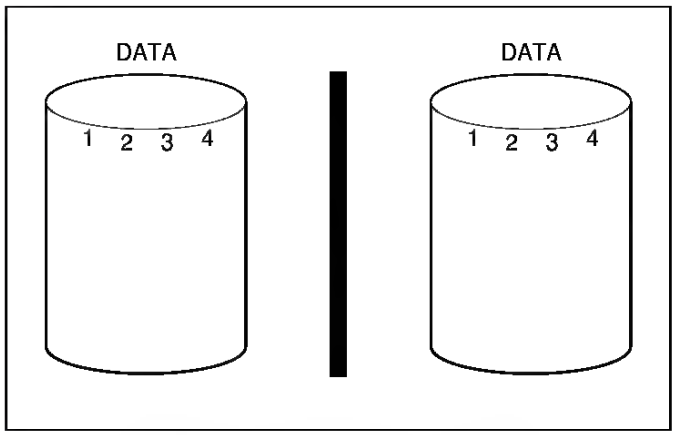

Figure D-7. **Drive Mirroring stores identical copy of the data**

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No Fault Tolerance (RAID 0)

RAID 0 does not provide fault tolerance. This level of RAID stripes data across all the drives of the array, but it does not incorporate a method to create redundant data. Therefore, if you choose this RAID option for any of your logical drives, you will experience data loss for that logical drive if one physical drive fails.

However, because none of the capacity of the logical drives is used for redundant data, RAID 0 offers the best processing speed and capacity. For this reason, you may consider assigning RAID 0 to drives that require large capacity and high speed but do not contain critical data.

Before choosing the RAID 0 option, be sure to consider the following:

- Disk failure will result in data loss for all RAID 0 logical drives.
- You cannot assign an online spare to an array containing a RAID 0 logical drive.

Online Spare

During configuration, consider assigning an online spare to further improve your system's fault tolerance. An online spare (sometimes called a hot-spare) is a drive the controller uses when a drive failure occurs. If a drive fails, the controller rebuilds the data that was on the failed drive onto the online spare. The controller also sends data that it would normally store on the failed drive directly to the online spare.

The online spare improves the overall system fault tolerance by automatically replacing a failed drive and quickly restoring the system to full RAID fault tolerance protection. During the time the system is operating in interim recovery mode with the failed drive, the system is vulnerable to an additional drive failure.

You can install up to four online spares for each SMART-2DH Controller. To provide an online spare, you must have at least one installed but unassigned physical drive and the system must be running some type of fault tolerance method (RAID 1, RAID 4, or RAID 5).

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Spare drives are automatically assigned to all volumes in an array and can be assigned to multiple arrays connected to the same controller.

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Performance Enhancement

Drive arrays allow data access performance to be dramatically enhanced over non-arrayed drives. In addition the SMART-2DH Controller has several other performance enhancement features that are discussed here.

Distributing Data and Data Striping

Distributing data makes it possible to access data concurrently from multiple drives in an array. This yields I/O rates many times faster than non-arrayed drives. Distributing data allows data striping.

Data striping is automatically generated on an array controller in order to store user data. A stripe is a collection of contiguous data that is distributed evenly across all physical drives in a logical drive. The width of the stripe (the amount stored on each physical drive) is selected to optimize the performance of the operating system.

For example, consider an operating system that typically requests data in 32-sector blocks. The SMART-2DH Controller distributes the data so that the first 32 sectors of data are on the first drive in the array. The SMART-2DH Controller continues distributing the next 32 sectors on the second drive, the next 32 sectors on the third drive, and so on. Evenly distributed data in an array improves performance by allowing access to all drives simultaneously.

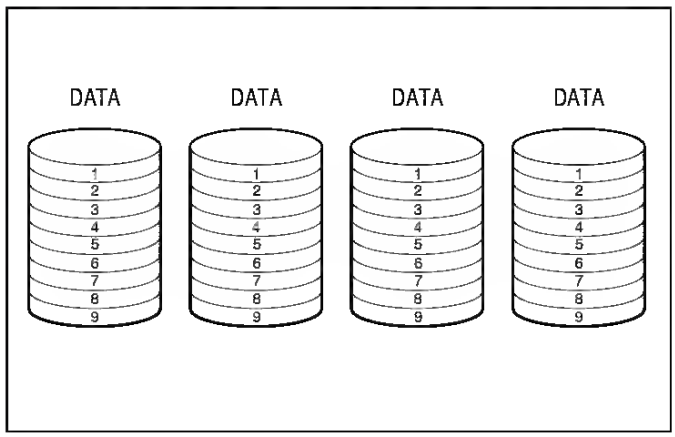

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Figure D-8. **Data Striping distributes data across all physical drives**

Array Accelerator

By serving as a posted write cache and read-ahead cache, the SMART-2DH Controller Array Accelerator dramatically improves the performance of read and write commands. The Array Accelerator is particularly useful for increasing performance in database and fault-tolerant configurations.

Performance

The Array Accelerator increases performance by having SMART-2DH Controller write data to the cache memory on the Array Accelerator rather than directly to the drives. The system can access this cache memory more than 100 times faster than accessing disk storage. The SMART-2DH Controller writes the data in the Array Accelerator to the drive array at a later time, when the controller is otherwise idle.

The controller also uses the Array Accelerator to increase performance by anticipating requests. The Array Accelerator uses a multi-threaded algorithm to predict the next likely read operation for the array. That data is pre-read into the Array Accelerator and therefore is ready before you access it. When the SMART-2DH Array Controller receives a read request for the cached data, it can be burst immediately into system memory at PCI bus speeds.

Data Protection

The Array Accelerator was designed to protect data integrity. Batteries and ECC memory protect the cache memory. This allows users to take full advantage of the performance without sacrificing reliability.

The Array Accelerator was also designed to be removable as a complete unit. This, along with the integrated batteries, means that the Array Accelerator may be removed from one SMART-2DH Controller and installed on another. If there is any data in the Array Accelerator that has not been written to the hard drive, it may be physically transferred to another SMART-2DH Controller. This might happen if the SMART-2DH Controller or server failed before the cached data could be stored on a drive.

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ECC Memory

To assure further data integrity, the Array Accelerator cache is made up of ECC memory. ECC (Error Checking and Correcting) memory will detect and correct all single-bit memory errors in multiple DRAMs. It will also detect all two-bit memory errors in any position and most three- and four-bit memory errors in a single DRAM. An entire DRAM can also fail without data loss. This ensures the correction of common memory errors without interrupting system operation.

Batteries

The Array Accelerator contains batteries that maintain any data cached there if a system power failure occurs. The batteries can preserve data in the Array Accelerator for up to four days. When power is restored to the system, an initialization feature writes the preserved data to the disk drives.

The cells used in the Array Accelerator batteries are recharged via a "trickle" charge applied while system power is present. If posted writes were stored in the memory of the Array Accelerator and power loss occurs, you must reinstate power within approximately four days or the data stored in the memory will be lost. Note that this depends on the present condition of the Array Accelerator batteries. If you feel this risk is too great, you can disable the Array Accelerator.

IMPORTANT: It is possible for the batteries to be depleted when you install a new SMART-2DH Controller. It can take up to 36 hours of system operation to charge the batteries fully. In this case, only the Array Accelerator is affected; your system will continue to run without interruption.

During Power-On Self-Test (POST), the SMART-2DH Controller checks the batteries. If the battery charge is low or depleted, a 1794 POST error message is displayed indicating that the Array Accelerator is disabled. The controller temporarily disables the Array Accelerator until the batteries reach 90 percent charge. The board continues to function properly, at a slightly lower performance, until the batteries reach 90 percent charge. At this point, the Array Accelerator is automatically enabled.

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Concurrent I/O Request Servicing

SMART-2DH Controller has the capability to service hundreds of I/O requests at a time. For example, if you request data that resides on the first drive and another user requests data that resides on the second drive, the controller can deliver both pieces of information concurrently. Figure D-9 illustrates concurrent request servicing.

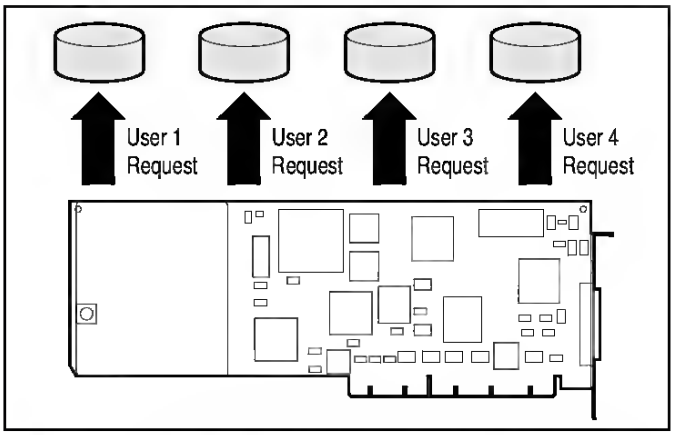

Figure D-9. **Concurrent Request Servicing handles several I/O requests**

Optimized Request Management

Optimized request management, also known as elevator trend sorting, is another performance enhancement feature provided by the SMART-2DH Controller. The controller receives and queues multiple data requests from the operating system. The controller then rearranges the requests in an order that optimizes performance.

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Consider the following example. The SMART-2DH Controller receives a request for a physical drive that is not currently active. The controller schedules the request immediately ahead of previously received requests already queued to other active drives within the array. This request management process operates concurrently with drive operations. The benefits of optimized request management increase as greater demands are made on the drive subsystem.

Bus Master Data Transfers

The SMART-2DH Controller is a bus master device that takes control of the PCI bus during high-speed transfers. This allows the system processor to handle application processing or other types of tasks. Data transfer occurs at rates of up to 133 megabytes/sec. for the PCI bus. Bus master high-speed transfers are particularly important when the supported models are used in conjunction with multiple expansion boards such as network interface controllers (NICs).

Expanding Storage Capacity

The SMART-2DH Array Controller allows the configuration of one or more separate logical drives into a single drive array. An existing drive array can be expanded by adding one or more logical drives to the array. To create the room for the additional logical drives, more physical drives must be added. See Figure D-10.

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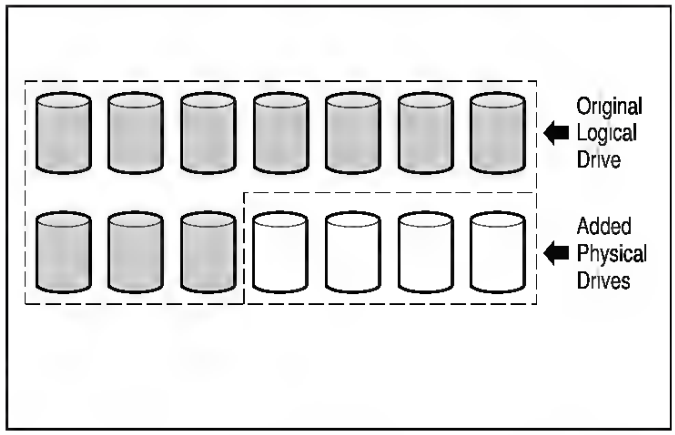

Figure D-10. **Begin Capacity Expansion by adding more physical drives**

When initiated by the Array Configuration Utility, the SMART-2DH Controller will automatically redistribute the data in the original logical drive to a logical drive that spans all of the physical drives in the array, including the added drives. The room left over is used to create additional logical drives, also spanning all physical drives. Both logical drives are then included in the drive array with expanded storage capacity. See Figure D-11.

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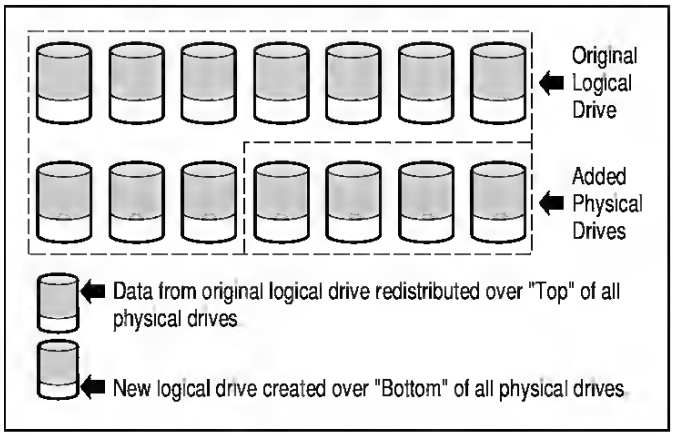

D-11. **Expanded array storage capacity with a second logical drive**

Example: Assume you have two ProLiant Storage Systems with a total of 10 drives and you want to expand this to the 14-drive maximum supported by one SMART-2DH Controller. With Array Configuration Utility running, simply install four matching drives in the empty drive bays. At this point your array will resemble Figure D-10, with the original data (original logical drive) represented by the gray shaded drives and the new drives unshaded. Execute the Array Configuration Utility, which is located on the Compaq SmartStart and Support Software CD, to start the expansion process as described in Chapter 5.

The SMART-2DH Controller will then redistribute the data to an equal portion of all the drives, using the same fault tolerance method used originally. This is still the first logical drive, but it now spans 14 drives instead of 10. Array Configuration Utility also detects the unused space on each drive (because each drive contains 10/14ths of the data that it used to) and helps you configure it into a second logical drive with its own fault tolerance, distributed over the extra space of all the drives.

When this process is finished both logical drives, one containing the original data and the new empty one, will be configured into a single array with more total capacity than the original one. Now your array will look more like Figure D-11, using the same shading scheme to represent the logical drives.

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It is not necessary for all *logical drives* in an array to be the same size or even have the same fault-tolerant configuration. Each logical drive is treated as a separate entity no matter how many physical drives it crosses. Each may be configured as best suits your needs.

It is important to remember that all *physical drives* in an array should be the same size (capacity). This is because each drive contains an equal portion of one or more logical drives and the portion sizes can only total the size of the smallest drive. While you are not prevented from expanding storage capacity with larger drives, the extra space cannot be used.

During expansion of an array that initially has two or more logical drives, the redistribution of data takes place one logical drive at a time. When the capacity expansion has completed, any newly created logical drive will become available. Under NT and NetWare, the new logical drive can then be appended to your existing logical volume.

Online Capacity Expansion

In certain cases, the SMART-2DH Controller and Array Configuration Utility also support making storage capacity changes online, without downing the server or storage system. These cases are:

- Windows NT or NetWare operating system (NetWare 3.11 not supported)
  and
- Hot-Pluggable drives

Because the Array Configuration Utility reconfigures the SMART-2DH Controller, online reconfiguration can only take place if Array Configuration Utility is running in the same environment as the normal server applications. The Array Configuration Utility is available in Windows NT or NetWare versions.(NetWare 3.11 is not supported.)

Hot-pluggable drives are required for online storage changes because non-hot-pluggable drives require that the server be powered down to add or remove the drive. All ProLiant Servers and Storage Systems support hot-pluggable drives.

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Disk Drive Upgrades

Additional storage space may be obtained with the same number of physical drives *in a fault-tolerant configuration* by replacing these drives with others of higher capacity. By replacing the drives one at a time, the data on the new drive is recreated from redundant information on the remaining drives. After each new drive has been rebuilt, the next can be replaced. After all drives have been replaced and rebuilt, the additional capacity on each drive can be utilized by adding a new logical drive. Array Configuration Utility will automatically recognize the unused space and guide you through the procedures to make use of it.

Other Fault Management Features

The SMART-2DH Controller and the network operating system offer several other fault management and data reliability features. These features include:

- Auto reliability monitoring
- Dynamic sector repairing
- Drive parameter tracking
- Drive failure alert features
- Interim data recovery
- Automatic data recovery
- Hot-pluggable drives (Compaq ProLiant Storage System, Compaq ProLiant Server, Rack-Mountable Compaq ProLiant Storage System or Rack-Mountable Compaq ProLiant Server)

The following items are not SMART-2DH features, but are functions possibly supported by the operating system:

- Controller duplexing
- Software based drive mirroring

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Auto Reliability Monitoring

Auto reliability monitoring (ARM) is a background process that scans hard drives for bad sectors in fault-tolerant logical drives. ARM also verifies the consistency of parity data in drives with data guarding or distributed data guarding. This process assures that you can recover all data successfully if a drive failure occurs in the future. ARM operates only when you select RAID 1 , RAID 4, or RAID 5.

Dynamic Sector Repairing

Using the dynamic sector repairing process, the controller automatically remaps any sectors with media faults it detects either during normal operation or during auto reliability monitoring.

Drive Parameter Tracking

Drive parameter tracking monitors more than 15 drive operational parameters and functional tests. This includes parameters such as read, write, and seek errors, spin-up time, cable problems, and functional tests such as track-to-track seek time, one-third stroke, and full stroke seek time. Drive parameter tracking allows the SMART-2DH Controller to detect drive problems and predict drive failure before they actually occur. It also makes pre-failure warranty possible on Compaq disk drives.

Drive Failure Alert Features

Drive failure features produce various drive alerts or error messages depending on the Compaq server model. Refer to the documentation included with your server to determine what drive failure features are included on your server model.

Other Compaq options such as Compaq Insight Manager and Compaq Server Manager/R provide additional drive failure features. See your Authorized Compaq Reseller for more information on these products.

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Interim Data Recovery

In RAID 5, RAID 4, or RAID 1 fault-tolerant configurations, if a drive fails, the system continues to operate in an interim data recovery mode. For example, if you had selected RAID 5 for a logical drive with four physical drives and one of the drives fails, the system continues to process I/O requests, but at a reduced performance level. Replace the failed drive as soon as possible to restore performance and full fault tolerance for that logical drive. Refer to Appendix G for more information on recovering from drive failure.

Automatic Data Recovery

After you replace a failed drive, automatic data recovery reconstructs the data and places it on the replaced drive. This allows a rapid recovery to full operating performance without interrupting normal system operations.

In general, the time required for a rebuild is approximately 15 minutes per gigabyte. The actual rebuild time however is dependent upon the rebuild priority set for the amount of I/O activity occurring during the rebuild operation and upon disk drive speed, and the number of drives in the array (RAID 4 and RAID 5). In RAID 4 and RAID 5 configurations, the rebuild time varies from 10 minutes/GB for three drives to 20 minutes/GB for 14 drives (using 9-GB wide-ultra hard drives).

NOTE: You must specify RAID 5, RAID 4, or RAID 1 through the Array Configuration Utility to make the recovery feature available. The drive failure alert system and automatic data recovery are functions of the SMART-2DH Controller; they operate independently of the operating system.

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Hot-Pluggable Drives

The SMART-2DH Controller, used with a Compaq ProLiant Storage System, a Rack-Mountable Compaq ProLiant Storage System, a Compaq ProLiant Server or Rack-Mountable Compaq ProLiant Server, supports hot-pluggable drives. You can install or remove these drives without turning off the system power. This feature is a function of the Compaq ProLiant Storage System and the Compaq ProLiant Server and operates independently of the operating system.

CAUTION: Do not turn off the Compaq ProLiant Storage System or the Compaq server when removing or installing the hot-pluggable replacement drives. If you turn off the ProLiant Storage System while the server power is on, the SMART-2DH Controller marks all the drives as "failed." This could result in permanent data loss when the Storage System is turned back on.

If a drive fails, the Service Required LED on the front panel of the Compaq ProLiant lights, indicating that a problem has occurred. Refer to the *Compaq ProLiant and Rack-Mountable ProLiant Servers Reference Guide* for more information on replacing drives. Also see Figure D-12 for conditions to safel replace a drive using the three indicators on each of the hot-pluggable drive trays.

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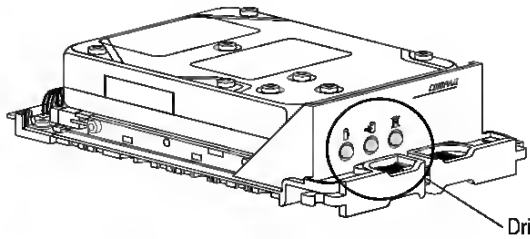

	OK to remove drive if not part of fault-tolerant configuration
	OK to remove failed drive
	DO NOT remove drive
	DO NOT remove drive
	DO NOT remove drive
	DO NOT remove drive
	DO NOT remove drive

OFF ON

Figure D-12. **Hot-pluggable drive replacement conditions**

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Controller Duplexing

Some operating systems support controller duplexing, a fault tolerance feature that requires two SMART-2DH Array Controllers. With duplexing, the two controllers each have their own drives that contain identical data. In the unlikely event of a SMART-2DH Controller failure, the remaining drives and SMART-2DH Controller service all requests.

Controller duplexing is not the same as duplexing the SCSI buses on a single SMART-2DH Controller. Controller duplexing is a function of the operating system and takes the place of other fault tolerance methods. Refer to the documentation included with your operating system for implementation.

Compaq recommends using hardware-based fault tolerance instead of controller duplexing. Hardware-based fault tolerance provides a much more robust and controlled environment for fault tolerance protection.

If you choose controller duplexing, configure each SMART-2DH Controller with RAID 0 to achieve maximum storage capacity. In addition, the following fault-tolerant features will not be available: Online Spare, Auto Reliability Monitoring, Interim Data Recovery, and Automatic Data Recovery.

Software-Based Drive Mirroring

Some operating systems support software-based drive mirroring as a fault tolerance feature. Software drive mirroring resembles hardware based drive mirroring (RAID 1), except that the operating system mirrors logical drives instead of physical drives.

A pitfall of software-based drive mirroring is that the operating system believes each logical drive is a separate physical drive. If you mirror logical drives in the same array and a physical drive fails, both logical drives in the mirrored pair will fail. You will not be able to retrieve your data.

Because software-based drive mirroring is a function of the operating system, refer to the documentation included with your operating system for implementation.

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Compaq recommends using hardware-based fault tolerance instead of software-based fault tolerance. Hardware-based fault tolerance provides a much more robust and controlled environment for fault tolerance protection.

If you choose software-based drive mirroring, create at least two arrays with RAID 0 to achieve maximum storage capacity. Then, when configuring the drive mirroring through the OS, mirror logical drives residing in different arrays. In addition, the following fault-tolerant features will not be available: Online Spare, Auto Reliability Monitoring, Interim Data Recovery, and Automatic Data Recovery. Proceed to Chapter 5 to set up your drive array(s) and fault tolerance.

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Appendix E
Upgrading or Replacing the Array Accelerator

The Compaq SMART-2DH Array Controller is provided with a removable 16-MB Array Accelerator. Previous versions of the SMART-2 Array Controller shipped with 4-MB Array Acceleration boards. The Array Accelerator is mounted on a removable daughter board so that it may be easily removed or replaced if necessary. Use this procedure when upgrading from the 4-MB to the 16-MB Array Accelerator board.

The SMART-2DH Controller Array Accelerator option has several unique features:

- It accelerates data storage by temporarily caching the data at high internal bus rates while transferring the data to the drives at their slower write speeds.
- It contains its own batteries to keep the data alive without board power, even if the Array Accelerator is removed from the SMART-2DH Controller.
- The memory is Error Checking and Correcting (ECC), providing error detection and correction reliability.
- It may be moved to another SMART-2DH Controller to complete the data transfer should the original SMART-2DH Controller fail.

You may want to remove or replace the Array Accelerator option board if:

- You want to upgrade from 4-MB cache to 16-MB cache.
- The Array Accelerator option is no longer needed.
- The host SMART-2DH Controller board fails and valid data is still stored in the Array Accelerator.

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Accessing the SMART-2DH Controller

To upgrade or replace the Array Accelerator, you must first remove the SMART-2DH Controller from the system.

1. Perform a normal system shutdown.
2. Unplug the server from the ac mains.

WARNING: To reduce the risk of personal injury from hot surfaces, allow the internal system components to cool before touching.

3. Open the server to gain access to the option expansion boards.

CAUSTION: Electrostatic discharge (ESD) can damage electronic components. Be sure you are properly grounded before beginning this procedure. See Appendix A for ESD information.

4. Remove the SMART-2DH Controller option board.

Removing the Array Accelerator Board

To remove the optional Array Accelerator daughter board from the SMART-2DH Controller:

1. Remove the plastic stabilizing bracket (1) by pulling outward on the handles at both ends. Bend the bracket until the daughter board is released. The bracket will come free of the assembly.
2. Twist the latch (2) 90° to allow the standoff to pull through the SMART-2DH Controller board.
3. Carefully pull the Array Accelerator daughter board away (3) from the SMART-2DH Controller board, unplugging the signal connectors.

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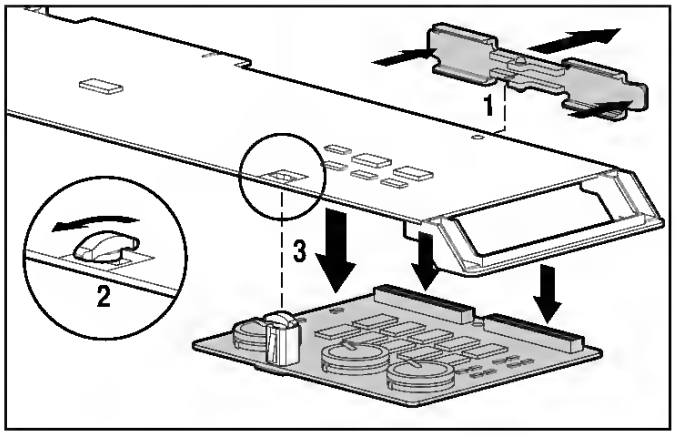

Figure E-1. Removing Array Accelerator Board from the SMART-2DH controller

WARNING: Do not abuse, recharge, disassemble, dispose of in fire or heat above 90°C, incinerate, or expose to water or fire. Disposal of the batteries or Array Accelerator module should be accomplished within compliance of local regulations or returned to Compaq Computer Corporation by established parts return methods.

Array Accelerator Installation

To install the Array Accelerator board on the SMART-2DH Controller:

1. Carefully align the connectors and plug the Array Accelerator board onto the SMART-2DH Controller (1). Be sure the connectors are fully mated by squeezing the boards together at the connector side.
2. Align the plastic standoff on the Array Accelerator board with the slot in the SMART-2DH Controller board. Push it through and rotate the top of the standoff 90° to lock the board in place (2).
3. Align the plastic stabilizing bracket with the holes on both boards, ensuring that the mated boards will fit between the lips on the bracket. Push the bracket in place until the detents snap through the holes (3).

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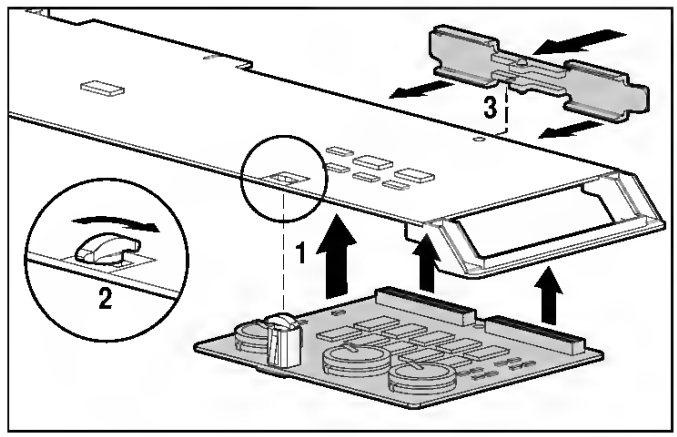

Figure E-2. **Installing the Array Accelerator board on the SMART-2DH controller**

Array Accelerator Switch

The array accelerator is equipped with a switch that may be activated to fine tune system performance for 16-MB operations utilizing multiple controllers, as shown in Figure E-3.

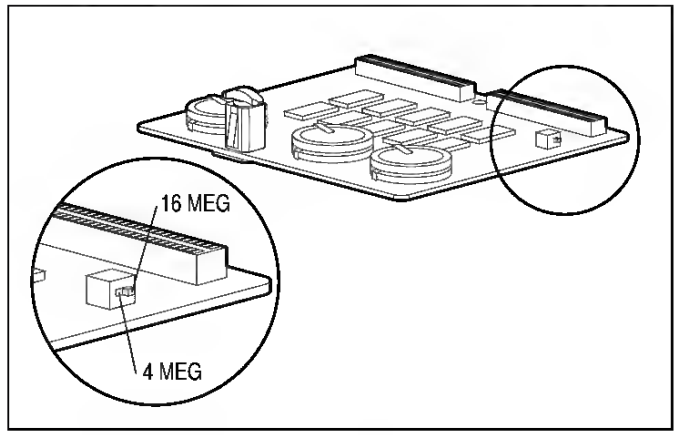

Figure E-3. **Array Accelerator switch positions**

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Appendix F
Upgrading from the SMART SCSI Array Controller

Users of the original Compaq SMART SCSI Array Controller may consider upgrading to the new SMART-2DH Array Controller. This appendix provides an upgrade procedure for moving arrayed drives from the SMART Controller to the SMART-2DH Controller. All user data and configuration information will be retained after the upgrade process.

IMPORTANT: Array configuration information is automatically transferred during the upgrade process. However, this is a one-way process. After upgrading to the SMART-2DH Controller, a manual reconfiguration procedure is required to move the drives and data back to the SMART Controller.

IMPORTANT: The upgrade procedure described below applies only to moving drives from the SMART Controller to the SMART-2DH Controller. Data will **NOT** be preserved if drives are moved from a Fast-SCSI-2 Controller or a Fast-Wide SCSI-2 Controller to either a SMART Controller or a SMART-2DH Controller.

To upgrade your system by replacing the SMART SCSI Array Controller with a new SMART-2DH Array Controller, perform the following steps:

1. Perform a complete backup of all affected drives. This is a safety precaution only. If properly executed, this upgrade procedure will not affect the arrayed data or drive location.
2. Upgrade your OS device driver to the new SMART-2DH Controller driver. The new drivers have been optimized to support the latest features and capabilities of the SMART-2DH Controller. The driver upgrade process is OS-dependent but is not difficult. See the readme information for your OS on the Compaq SmartStart and Support Software CD for more information depending on your OS.

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3. Upgrade your System ROM to the most current version using the Compaq System ROMPaq v2.22 or later. This step is a fundamental requirement. The System ROM **must** be upgraded before installing the SMART-2DH Controller. Your SMART-2DH Array Controller Option Kit may include a diskette containing System ROMPaq v2.22 or later. If so, use that diskette to upgrade the system ROM. Otherwise, System ROMPaq is distributed on the Compaq SmartStart and Support Software CD included in the SMART-2DH Array Controller option kit. Due to possible data loss, do not use System ROMPaq version 2.21 distributed on Support Software CD v1.18 or 1.19 or on SmartStart 2.50 or 2.50a. Review Chapter 2 in this guide for specific instructions on running System ROMPaq.
4. Perform a normal shutdown and turn OFF the server.
5. Examine the SCSI cable connector layouts. They differ between the SMART Controller and the SMART-2DH Controller. See Figure F-1.

   The **SMART Controller** has a 100-pin external connector on the mounting bracket that connects to the Y cable that separates into two 50-pin Fast-SCSI-2 connectors, Port 1 and Port 2. These port numbers should be labeled on the Y cable and can be connected to external drives in Compaq ProLiant Storage Systems or other external storage units. Port 1 is also available as an internal connector on the top edge of the controller for internal drive connections. Note that Port 1 can be used either internally or externally, but it cannot be used both ways at the same time. Note the existing cable connections and port numbers for your system before disconnecting any cables.

   The **SMART-2DH Controller** has an external 68-pin Fast-Wide SCSI-2 connector on the mounting bracket for Port 2 only. There is an internal 68-pin Fast-Wide SCSI-2 connector at the top edge of the controller for Port 1. This port can be used for internal drives through a standard internal ribbon cable, or for external drives through a special internal/external cable (included) and a connector panel or slot connector bracket (included) at the back of the server. This allows Port 1 connections to external drives in Compaq ProLiant Storage Systems. There is no Y cable required for the SMART-2DH Controller.

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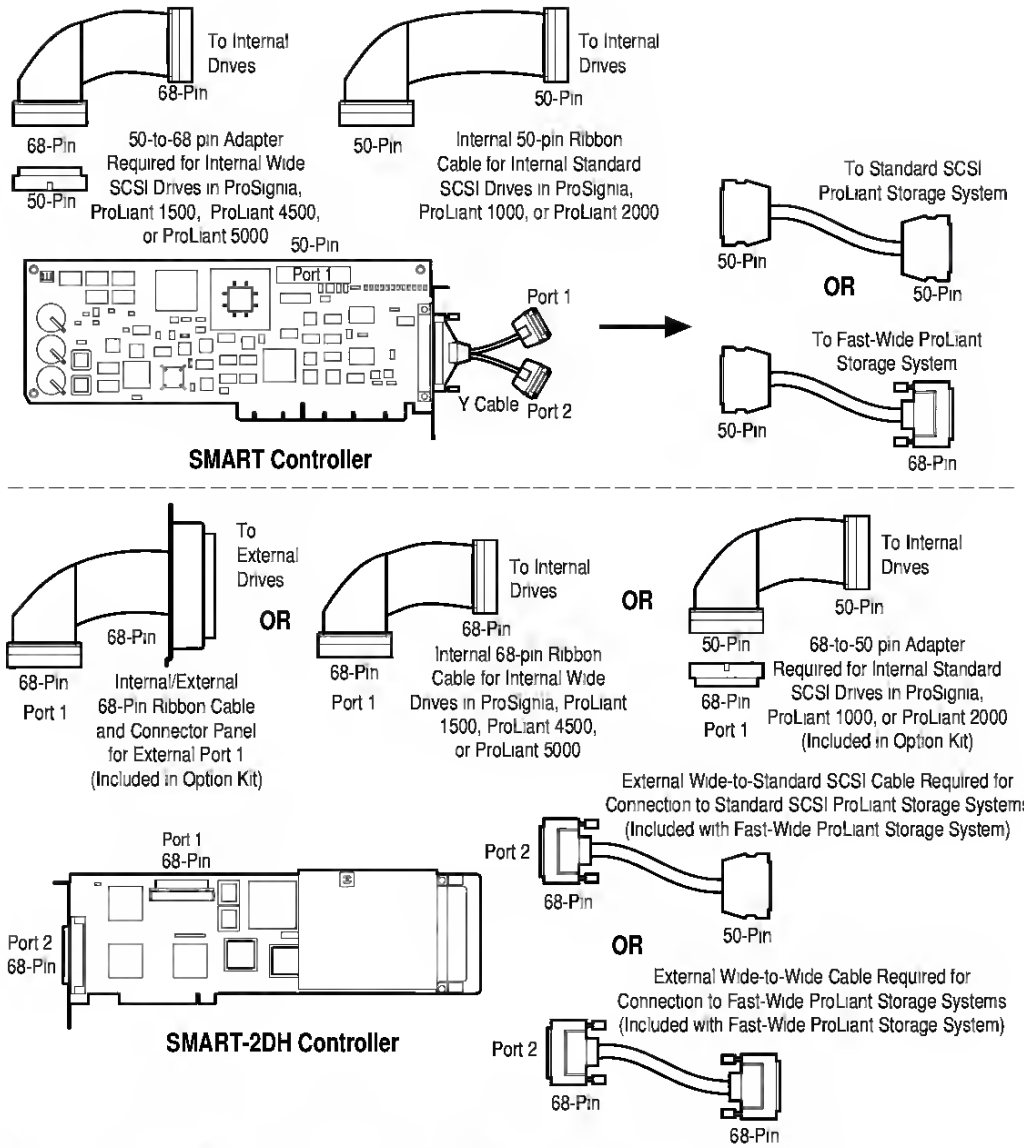

Figure F-1. **Cable and connector configurations for SMART and SMART-2DH array controllers**

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For the upgrade process, be sure to attach disk drives (internal to the sever or external to ProLiant Storage Systems) to the same port numbers as described above. **It is necessary to connect internal drives and external ProLiant Storage Systems to the same numbered ports on the SMART-2DH Controller as they were on the SMART Controller.** If you get these port connections wrong, a system power-on (POST) message will advise you to reconnect to the correct ports.

The SMART-2DH Controller uses 68-pin Fast-Wide SCSI-2 connectors; therefore:

- If you are connecting to Fast-SCSI-2 internal drives, you must attach a 68-pin to 50-pin cable adapter (included in the SMART-2DH option kit) to the Port 1 connector to use your existing 50-pin internal ribbon cable.
- If you are connecting to a Fast-SCSI-2 external storage system, use a 68-pin to 50-pin external cable, which must be ordered separately: (6-ft, 189632-002; 12-ft, 189632-003).
- If you are connecting to a Fast-Wide SCSI-2 external storage system, use a 68-pin to 68-pin external cable included with the ProLiant Storage System.

For more detailed information on cable connections for your system, refer to Chapters 3 through 7, depending on your Compaq server type.

6. Remove the SMART Controller and replace it with the SMART-2DH Controller. Refer to Chapters 3 through 7. It is not necessary to put the new controller in the same expansion slot as the old controller.
7. Reconnect all internal and external drive cables, paying close attention to the port numbers as noted in Step 5.

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8. Turn on the server and run the Compaq System Configuration Utility (Version 2.35B or later). It can be run from the SmartStart and Support Software CD, from the System Partition, or from diskettes. This configuration utility will recognize the SMART-2DH Controller and allow you to change parameters such as controller order and interrupt number, if desired. You will not see logical drive information with this utility since SMART-2DH Controller logical drives are configured with the new Compaq Array Configuration Utility. Save the configuration and reboot the server.

   If you would like, you can run the Array Configuration Utility to see the configuration of your logical drive(s), look at fault tolerance level, and so on. However, this is not necessary since your configuration information is automatically preserved.

After completing these steps, the upgrade process is complete; you can take full advantage of the SMART-2DH Array Controller.

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Appendix G
Recovering from Drive Failure

The purpose of fault-tolerant configurations on the SMART-2DH Array Controller is to protect against data loss due to drive failure. Although the SMART-2DH Array Controller firmware is designed to protect against normal drive failure, it is imperative that the system operator perform the correct actions to recover from a drive failure without inadvertently inducing any additional drive failures. Multiple drive failures in the same array generally result in data loss (exceptions include failures following activation of a spare drive, and failure of drives in a mirroring configuration that are not mirrored to one another).

Recognizing a Drive Failure

A drive failure can be recognized by the system operator in one of several ways:

- Amber LED will be illuminated on failed drives in a hot-pluggable tray. This, however, assumes the storage system is powered-on and the SCSI cable is working. Note that the amber LED may be illuminated briefly when a hot-pluggable drive is inserted; this is normal.
- Amber LED will be illuminated on the front of a ProLiant Storage System if failed drives are inside (other problems such as fan failure or over-temperature conditions will also cause this LED to be illuminated).
- A Power-On Self-Test (POST) message will list failed drives whenever the system is restarted (assumes that one or more "good" drives are detected by the controller). (See Appendix E for interpretation of POST messages).
- Drive Array Advanced Diagnostics (DAAD) will list all failed drives. An online version on DAAD is also available in NT environments.
- Compaq Insight Manager can be used to detect failed drives remotely across a network.

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Problems such as reduced system performance or disk errors reported by the operating system do not necessarily imply that a drive has or has not been failed. If drive failures or repeated errors are suspected, Compaq recommends that Drive Array Advanced Diagnostics be run on the system.

Fault Tolerance and Drive Failure

In the event of a drive failure, the condition of the logical drive will vary depending upon the fault tolerance method used. Since a single array of physical drives can contain multiple logical drives with differing fault tolerance methods, conditions of each logical drive on the same array are not necessarily the same. At any one time, if more drives are failed than the fault tolerance mode allows, fault tolerance is referred to as being "compromised" and the condition of the logical drive can be referred to as "failed." If a logical volume is "failed," all requests from the operating system will be rejected with "unrecoverable" errors.

A Non-Fault-Tolerant (RAID 0) Logical Drive

- Can sustain no drive failures. If any physical drive in the array is failed, the condition of all non-fault-tolerant logical drives in the same array will also be "failed." This is because data is striped across all drives in the array.

A RAID 1 (Mirroring) Logical Drive

- Can sustain multiple drive failures as long as failed drives are not mirrored to one another.
- Will be in a "failed" condition if any two failed drives are mirrored to one another.
- Will be in a "regenerating" condition if at least one drive is failed and no failed drives are mirrored to one another.
- Will be in a "rebuilding" condition if a previously failed drive has been replaced and the replacement drive is rebuilding. The volume may also be in a "rebuilding" condition following a drive failure if a spare drive was previously assigned and is rebuilding.

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In any RAID 1 logical drive on the SMART-2DH Controller having N physical drives in the array (not including spare drives), the first N/2 physical drives are normally mirrored in consecutive order to the second N/2 physical drives. When determining the order, number each drive in the array by increasing IDs on the first SCSI bus, followed likewise by drives on the second SCSI bus.

- Can sustain a single drive failure. The logical drive will be in a "regenerating" condition if one drive is failed.
- Will be in a "failed" condition if more than one drive is failed.
- Will be in a "rebuilding" condition if a previously failed drive has been replaced and the replacement drive is rebuilding. The volume may also be in a "rebuilding" condition following a drive failure if a spare drive was previously assigned and is rebuilding.

Spare Drives

In the event of a drive failure, if a spare drive is assigned and available, the spare drive acts as an immediate replacement for the failed drive. Data is automatically reconstructed from the remaining drive(s) in the volume and written to the spare drive via the Automatic Data Recovery process. Once the spare drive is completely built, the logical drive is again running at full fault tolerance, and is then able to sustain another subsequent drive failure. Note, however, that if another drive were to fail before the spare drive is completely built, the spare drive cannot prevent failure of the entire logical drive. Also note that it is possible for non-correctable disk errors to prevent completion of the Automatic Data Recovery process (discussed below).

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Replacing a Failed Drive

Failed drives in hot-pluggable trays can be removed and replaced while host system and storage system power are both ON. Hot-pluggable drives can also be replaced when the power is OFF. Remember, however, to NEVER TURN OFF an external storage system while the host system power is on. This would result in the failure of all drives in the storage system, which would likely compromise your fault tolerance. When a hot-pluggable drive is inserted, all disk activity on the controller will be temporarily paused while the drive is spinning up (usually 20 seconds or so). If the drive is inserted while power is ON, in fault-tolerant configurations, recovery of data on the replacement drive will automatically begin (indicated by blinking online LED).

Non-hot-pluggable drives should only be replaced while the system power is OFF. On all non-hot-pluggable drives, be sure to check the SCSI ID jumpers to make sure that the correct drive is being replaced. *To prevent compromising the fault tolerance, it is imperative that the correct physical drive be replaced.* Also, be sure that the SCSI ID jumpers are set to the same SCSI ID on the replacement drive. Note that the SCSI ID jumpers may be located at different places on different drive models, but it is imperative that the SCSI ID on the replacement drive *always* be set to the same value as the original failed drive to prevent SCSI ID conflicts which could compromise the fault tolerance.

The capacity of replacement drives must be at least as large as the capacity of the other drives in the array. Drives that are insufficient capacity will immediately be failed by the controller without starting the Automatic Data Recovery.

CAUTION: If the SMART-2DH Array Controller has a failed drive, replace this drive with a new or known-good replacement drive. In some cases, a drive that has previously failed by the controller may appear to be operational after the system is power-cycled, or after removal and reinsertion of a hot-pluggable drive. However, this practice is highly discouraged as the use of such "marginal" drives may eventually result in data loss.

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Automatic Data Recovery

If a drive in a fault-tolerant configuration is replaced while the system power is OFF, the controller will display a Power-On Self-Test (POST) message during the subsequent system startup. This indicates that the replacement drive has been detected and that Automatic Data Recovery may need to be started. Press **F1** to initiate the background Automatic Data Recovery process. If Automatic Data Recovery is not enabled, the logical drive will remain in a "ready to recover" condition and the same query will be displayed at the next system restart.

Replacement drives are not considered to be "online" until Automatic Data Recovery is completed, at which time the online LED stops blinking and is on "solid." Any drives that are not yet "online" are treated as if they are "failed" when trying to determine whether fault tolerance will be compromised. For example, in a RAID 5 logical drive with no spare and one drive rebuilding, another drive failure at this time would result in a "failure" condition for the entire logical drive.

In general, the time required for a rebuild is approximately 15 minutes per gigabyte. The actual rebuild time however is dependent upon the rebuild priority set for the amount of I/O activity occurring during the rebuild operation and upon disk drive speed, and the number of drives in the array (RAID 4 and RAID 5). In RAID 4 and RAID 5 configurations, the rebuild time varies from 10 minutes/GB for three drives to 20 minutes/GB for 14 drives (using 9-GB wide-ultra hard drives).

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Automatic Data Recovery Failure

During Automatic Data Recovery, if the online LED of the replacement drive stops blinking and all other drives in the array are still online, the Automatic Data Recovery process may have been abnormally terminated due to an non-correctable read error from another physical drive during the recovery process. The background Auto-Reliability Monitoring process is meant to help prevent this problem, but it cannot do anything about certain issues such as SCSI bus signal integrity problems. Reboot the system and a POST message should confirm the diagnosis. Retrying Automatic Data Recovery may possibly help. If not, a backup of all data on the system, surface analysis (using User Diagnostics), and restore is the recommended course of action in this unfortunate situation.

During Automatic Data Recovery, if the online LED of the replacement drive stops blinking and the replacement drive is failed (amber failure LED illuminated or other LEDs go out), the replacement drive is producing unrecoverable disk errors. In this case, the replacement drive should be removed and replaced with another replacement drive.

Compromised Fault Tolerance

If fault tolerance is ever compromised due to failure of multiple drives, the condition of the logical drive will be "failed" and "unrecoverable" errors will be returned to the host. Data loss is probable. Insertion of replacement drives at this time will not improve the condition of the logical drive. If this occurs, first try turning the entire system off and on. In some cases, an intermittent drive will appear to work again (perhaps long enough to make copies of important files) after cycling power. If a 1779 POST message is displayed, press **F2** to reenable the logical drive(s). Remember that data loss has likely occurred and any data on the logical drive is suspect.

Fault tolerance may be compromised due to non-drive problems such as a faulty cable, faulty storage system power supply, or a user accidentally turning off an external storage system while the host system power was on. In such cases, the physical drives do not need to be replaced. However, data loss can still occur in this situation, especially if the system was busy at the time the problem developed.

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In cases of "legitimate" drive failure, once copies of important data have been made (if possible), replace any drives that have failed to prevent further drive problems in the future. After these (multiple) drives are replaced, the fault tolerance may again be compromised, power may need to be cycled, and the 1779 POST message may again be displayed. Press **F2** to reenable the logical drive(s), recreate your partitions, and restore all data from backup.

Because of the risk that fault tolerance may be compromised at some point in the future, make regular backups of all logical drives.

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Appendix H
POST Error Messages

The SMART-2DH Controller produces diagnostic error messages at reboot. Many of these Power-On Self-Test (POST) messages are self-explanatory and suggest corrective actions for troubleshooting. Detailed information and corrective actions are listed below.

NOTE: SCSI port 1 refers to internal or external drives attached to the internal port 1 connector. SCSI port 2 refers to external drives installed in a Compaq ProLiant Storage System attached to the external port 2 connector.

Table H-1
POST Error Messages

Code	Meaning	Recommended Action
17D2	SCSI Cable Error Detected. System Halted.	This message indicates a termination or cabling problem with the system board integrated SCSI controller. Refer to cabling diagrams in the *SMART-2DH Array Controller Installation Guide* for your system.
172D	Slot x Drive Array - S.M.A.R.T. Hard Drive Detects Imminent Failure SCSI: Port y: SCSI ID x.	The indicated drive has reported a S.M.A.R.T. predictive-failure condition. It may fail at some time in the future. If this drive is part of a non-fault-tolerant configuration, back up all data before replacing the drive and restore all data afterwards. If this drive is part of a fault-tolerant configuration, do not replace this drive unless all other drives in the array are on-line. Select **F1** key to resume.
1724	Slot x Drive Array - Physical Drive Position Changes(s) Detected - Logical drive configuration has automatically been updated.	This message indicates that logical drive configuration has been updated automatically following physical drive position changes. Select **F1** key to resume.

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continued

POST Error Messages *continued*

1726	Slot x Drive Array - Array Accelerator Memory Size Change Detected.	This message indicates that the array accelerator configuration has been updated automatically due to replacement of the Array Accelerator (or controller) with one having different memory size. Select **F1** key to resume.
1727	Slot x Drive Array - New Logical Drive(s) Attachment Detected. If more than 32 logical drives, this message will be followed by: Auto-configuration failed: Too many logical drives.	This message indicates that the controller has detected an additional array of drives that was attached when the power was off. The logical drive configuration information has been updated to add the new logical drives. The maximum number of logical drives supported is 32-additional logical drives will not be added to the configuration. Select **F1** key to resume.
1764	Slot x Drive Array - Capacity Expansion Process is Temporarily Disabled (followed by one of the following:) 1. Expansion will resume when Array Accelerator has been reattached. 2. Expansion will resume when Array Accelerator has been replaced. 3. Expansion will resume when Array Accelerator RAM allocation is successful. 4. Expansion will resume when Array Accelerator battery reaches full charge. 5. Expansion will resume when Automatic Data Recovery has been Completed. (RESUME = **F1** KEY)	The capacity expansion process has been temporarily disabled for the reason indicated, and will automatically resume. If the array accelerator has been removed, you must reinstall it for capacity expansion to continue.
1765	Slot x Drive Array Dption RDM Appears to Conflict with an ISA Card - ISA cards with 16-bit memory cannot be configured in	Remove or reconfigure the conflicting ISA card, referring to the directions provided with the ISA card. Alternatively, the Dption RDM can be

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	memory range C0000 to OFFFF along with SMART-2/E 8-bit Option ROM due to EISA bus limitations. Please remove or reconfigure your ISA card. (RESUME = **F1** KEY)	disabled on the SMART-2/E controller via the System Configuration Utility if a SMART-2/E is not the primary (boot) controller.

continued

POST Error Messages *continued*

1766	Slot x Drive Array requires System ROM Upgrade. Run System ROMPaq Utility (RESUME = **F1** KEY)	Run the latest version of System ROMPaq. See Chapter 3 for details.
1767	Slot x Drive Array Option ROM is Not Programmed Correctly or may Conflict with the Memory Address Range of an ISA Card. Check the Memory Address Configuration of installed ISA Card(s) or Run Option ROMPaq Utility to attempt SMART-2/E Option ROM Reprogramming. (RESUME = **F1** KEY)	Check the Memory Address Range of any ISA cards that may be installed, and verify that they do not conflict with the address of the SMART-2/E Option ROM as shown via the System Configuration Utility. If there is no conflict, run Option ROMPaq and attempt to reprogram the SMART-2/E Option ROM as described in the section, "Running Option ROMPaq," in Chapter 3.
1768	Slot x Drive Array - Resuming logical drive expansion process.	No action required. This message appears whenever a controller reset or power cycle occurs while array expansion is in progress.
1769	Slot x Drive Array - Drive(s) disabled due to failure during expansion (possibly followed by one of the following additional details:) 1. Array Accelerator Removed or Failed; Expansion Progress Data Lost. 2. Expansion Progress Data Could Not Be Read From Array Accelerator. 3. Expansion Aborted due to Unrecoverable	Data has been lost while expanding the array, therefore the drives have been temporarily disabled. Press **F2** to acknowledge the data loss and reenable the logical drives. Restore data from backup. If the Array Accelerator has failed, replace the Array Accelerator board after the capacity expansion progress has terminated. NEVER turn off the system and

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Drive Errors. 4. Expansion Aborted due to Array Accelerator Errors. Select **F1** to continue with logical drives disabled Select **F2** to accept data loss and to re-enable logical drives (RESUME = **F1** OR **F2** KEY)	replace the Array Accelerator board if capacity expansion is in progress.

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POST Error Messages *continued*

1774	Slot x Drive Array - Obsolete data found in Array Accelerator. Data found in accelerator was older than data found on drives. Obsolete data has been discarded. (RESUME = **F1** KEY)	Data found in Array Accelerator is older than data found on drives due to drives having been disconnected, used on another controller, and then reconnected. Press **F1** to discard older data.
1775	Slot x Drive Array - ProLiant Storage System Not Responding SCSI Port (y): Check storage system power switch and cables. Turn the system power off while checking the ProLiant power and cable connections, then turn the system power back on to retry. (RESUME = **F1** KEY)	Turn off power to system. Check external ProLiant power switch - external drives must all be powered up before or at the same time as the main system. Check cables. If retry does not help, try replacing the cable, ProLiant firmware, ProLiant backplane, or the SMART-2 Controller.
1776	Slot x Drive Array - SCSI Port (y) Termination Problem Detected (RESUME = **F1** KEY)	The termination power signal for the specified SCSI port was shorted to ground. Termination power was automatically turned off to prevent damage to the internal hardware. Turn off the server power and check the cabling to the specified SCSI port. Replace damaged cables/faulty SCSI devices attached to cable.

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POST Error Messages *continued*

1777	Slot x Drive Array - ProLiant Drive Storage System Problem Detected (followed by one or more of the following): SCSI Port (y): Cooling Fan Malfunction Detected SCSI Port (y): Overheated Condition Detected SCSI Port (y): Side-Panel must be Closed to Prevent Overheating SCSI Port (y): Redundant Power Supply Malfunction Oetected SCSI Port (y): Wide SCSI Transfer Failed SCSI Port (y): Interrupt Signal Inoperative (RESUME = **F1** KEY)	Check cooling fan operation by placing hand over fan. Check internal plenum cooling fan in tower servers or storage systems. If fan is not operating, check for obstructions and check all internal connectors. Replace unit side panel if removed. If the ProLiant Storage System power LED is amber instead of green, this indicates a redundant power supply failure. Check SCSI cables. Note that port 1 refers to the "internal" SCSI bus, and port 2 refers to the "external" SCSI bus. If the message indicates to check SCSI cables, verify your cabling using the diagrams in the *SMART-2DH Array Controller Installation Guide*. If the routing is correct, replace cables on the specified port until the POST message is eliminated.
1778	Slot x Drive Array resuming Automatic Data Recovery process.	No action required. This message appears when a controller resets or power cycle occurs while Automatic Data Recovery is in progress.
1779	Slot x Drive Array - Replacement drive(s) detected OR previously failed drive(s) now appear to be operational: Port (y): SCSI ID (*x*): Restore data from backup if replacement drive *x* has been installed.	If this message appears and drive *x* (identified by its SCSI ID) has not been replaced, this indicates an intermittent drive failure. This message also appears once immediately following drive replacement before data is restored from backup.
1783	Slot x Drive Array Controller Failure.	If this message appears immediately following a ROM installation, the ROM is defective or not installed properly. Check that the controller is firmly inserted in its slot. Try upgrading the System ROMs. Otherwise, replace the SMART-2DH Controller.
1784	Slot x Drive Array Drive Failure. The following SCSI drive(s) should be replaced: SCSI Port (y) SCSI IO (*x*)	Check for loose cables. Replace defective drive *x* and/or cable(s).

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continued

POST Error Messages *continued*

1785	Slot 1 Drive Array not Configured (followed by one of the following:) (1) Run Compaq Array Configuration Utility. (2) No drives detected. (3) Array Accelerator Memory Size Increased. (4) External Cable(s) Attached to Wrong SCSI Port Connector(s). (5) Drive positions cannot be changed during Capacity Expansion. (6) Drive positions appear to have changed. (7) Configuration information indicates drive positions beyond the capability of this controller. This may be due to drive movement from a controller that supports more drives than the current controller. (8) Configuration information indicates drives were configured on a controller with a newer firmware version.	(1) Run the Compaq Array Configuration Utility. (2) Turn off system and check SCSI cable connections to make sure drives are attached properly. (3) Run the Compaq System Configuration Utility. (4) Turn system power OFF and swap SCSI port connectors to prevent data loss. (5-6) Run Drive Array Advanced Diagnostics if previous positions are unknown. Then turn system power OFF and move drives to their original positions. (7) To avoid data loss turn system power OFF and reattach drives to the original controller. (8) To avoid data loss, reattach drives to original controller or upgrade controller firmware to the version on the original controller using Option ROMPaq. Select **F1** key to resume.
1786	Slot x Drive Array Recovery Needed. The following SCSI drive(s) need Automatic Data Recovery SCSI Port (y): SCSI ID (x) Select **F1** to continue with recovery of data to drive. Select **F2** to continue without recovery of data to drive. *Or* Slot x Drive Array Recovery Needed. The following SCSI drive(s) need Automatic Data Recovery SCSI Port (y): SCSI ID (x) Select **F1** to retry Automatic Data Recovery Select **F2** to continue without starting Automatic Data Recovery	The message normally appears when a drive was replaced in a fault-tolerant configuration with system power off. In this case, press **F1** to start the automatic data recovery process. The "previously aborted" version of the 1786 POST message will appear if the previous rebuild attempt was aborted for any reason. Run Drive Array Advanced Diagnostics (DAAD) for more information. If the replacement drive was failed, try using another replacement drive. If rebuild was aborted due to a read error from another physical drive in the array, you'll need to back up all readable data on the array, run Diagnostics Surface Analysis, and then restore your data.
1787	Slot x Drive Array Operating in Interim Recovery Mode. The following SCSI drive(s)	Following a system restart, this message reminds you that drive *x* is defective and fault

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should be replaced: SCSI Port (y): SCSI ID (*x*)	tolerance is being used. Drive *x* needs replacement as soon as possible A loose or defective cable may also cause this error.

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POST Error Messages *continued*

1788	Slot x Drive Array Reports Incorrect Drive Replacement. The following SCSI drive(s) should have been replaced: SCSI Port (y): SCSI ID (*x*). The following SCSI drive(s) were incorrectly replaced: SCSI Port (y): SCSI ID (z). Select **F1** to continue - drive array will remain disabled. Select **F2** to reset configuration - all data will be lost.	The drives indicated were installed in the wrong place, so they have been disabled. Reinstall the drives correctly. Press **F1** to restart the computer with the drive array disabled. Run DAAD for more information. *-Or-* Press **F2** to use the drives as configured and lose all the data on them.
1789	Slot x Drive Array Physical Drive(s) Not Responding. Check cables or replace the following drives: SCSI Port (y): SCSI ID (x) Select **F1** to continue - drive array will remain disabled. Select **F2** to failed drives that are not responding - Interim Recovery Mode will be enabled if configured for fault tolerance.	This message indicates that previously operating drives are missing or inoperative following a cold or warm reset. Turn off system and check cable connections. If cables are connected, replace the drive. Press **F1** to restart the computer with the drive array disabled. *-Or-* If you do not want to replace the drives now, press **F2**.
1792	Slot x Valid Data Found in Array Accelerator. Data automatically written to drive array.	While the system was in use, power was interrupted or the system was restarted while data was in the Array Accelerator memory. Power was then restored within four days, and data in the Array Accelerator was flushed to the drive array.

continued

NOTE: Message 1788 might also be displayed inadvertently due to a bad power cable connection to the drive or a defective SCSI cable. If this message was due to a bad power cable connection, repair the connection and press **F2**. If this message is not eliminated by pressing **F2**, run the Drive Array Advanced Diagnostics Utility.
-OR-
If this message was not due to a bad power cable connection, and the drive was not replaced, this could indicate a defective SCSI cable. Contact your Authorized Compaq Service Provider.

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POST Error Messages *continued*

1793	Slot x Drive Array - Array Accelerator Battery Depleted. Data in Array Accelerator has been lost. (Error message 1794 also displays.)	While the system was in use, power was interrupted while data was in the Array Accelerator memory. Power was not restored within four days, and data in the Array Accelerator was lost. Check all files for potential data corruption. *-Or-* The Array Accelerator batteries have become discharged while the system was off for an extended period (Array Accelerator board Rev. A or earlier). *-Or-* The controller was replaced with one that was on the shelf for an extended period; batteries are temporarily discharged (Array Accelerator Rev. A or earlier).
1794	Slot x Drive Array - Array Accelerator Battery Charge Low. Array Accelerator is temporarily disabled. Array Accelerator will be reenabled when battery reaches full charge.	The battery charge is below 90%. Posted writes are disabled. When the batteries are fully charged, the Array Accelerator will automatically be reenabled and this POST message will be discontinued. Replace the Array Accelerator or the SMART-2DH Controller if batteries do not recharge within 36 power-on hours.
1795	Slot x Drive Array - SMART-2 Controller Configuration Error. Data does not correspond to this drive array. Array Accelerator is temporarily disabled.	The data stored in the Array Accelerator does not correspond to this drive array. Match the Array Accelerator to the correct drive array. *-Or-* Run the Compaq System Configuration Utility to clear data in the Array Accelerator.
1796	Slot x Drive Array - Array Accelerator is not responding. Array Accelerator is temporarily disabled.	The Array Accelerator is not responding. Replace the Array Accelerator or the SMART-2DH Controller.

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POST Error Messages *continued*

1797	Slot x Drive Array - Array Accelerator Read Error Dccurred. Data in Array Accelerator has been lost. Array Accelerator is disabled.	Replace the Array Accelerator or the SMART-2DH Controller. Restore data from backup.
1798	Slot x Drive Array - Array Accelerator Self-Test Error Dccurred. Array Accelerator is disabled.	Replace the Array Accelerator or the SMART-2DH Controller.
1799	Slot x Drive Array - Drive(s) Disabled due to Array Accelerator Data Loss. Select **F1** to continue with logical drives disabled. Select **F2** to accept data loss and to reenable logical drives.	Data stored in the Array Accelerator has been lost, therefore the drives have been temporarily disabled. Press **F2** to acknowledge the data loss and reenable the logical drives. Restore data from backup.

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Appendix I
Questions and Answers

This Appendix contains several common questions about the SMART-2DH Array Controller. Along with the answers to the questions, you will see the location in this guide where you can find more information.

Q. How many SMART-2DH Controllers can I install in my system, and how many internal and external drives?

A. The maximum number of SMART-2DH Controllers you can install in your system depends on your server and several other factors specific to your configuration. See Chapter 2 for information defining some of these factors.

The maximum number of internal and external drives that you can install in your system also depends upon your server and your choice of hard drives Each SMART-2DH Controller has two SCSI buses and each bus can support up to seven drives. See Chapter 2.

Q. Does the SMART-2DH Controller support SCSI tape drives and CD-ROM Drives?

A. No; the SMART-2DH Controller *only* supports Fast-SCSI-2, Fast-Wide SCSI-2, and Wide-Ultra SCSI-3 disk drives.

Q. I installed the hard drives in my server. Must I now terminate each drive?

A. No; if you installed hard drives in a server with a SMART-2DH Controller, all termination requirements are met by the controller and the SCSI signal cable. Therefore, the individual drives should have termination removed.

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Q. I have several hard drives in my server and in the Compaq ProLiant Storage System. What SCSI IDs do I assign for these drives?

A. Each hard drive must have a unique SCSI ID for *each* controller port. If your drives are installed in a Compaq ProLiant Server, a Rack-Mountable Compaq ProLiant Server, a Compaq ProLiant Storage System, or a Rack-Mountable Compaq ProLiant Storage System, the SCSI IDs are *automatically* set according to the bay in which the drives are installed and do not need to be manually set."

If your drives are installed in a Compaq ProSignia, ProSignia 500, ProSignia 300, ProSignia VS, or Systempro/XL, you must manually set the SCSI ID jumpers.

Q. Should SCSI IDs in my system be consecutive?

A. No. It is no longer required that the IDs of devices on each SCSI bus be consecutive. However, IDs must still be unique for each device on a single SCSI bus.

CAUTION: Do not interchange SCSI IDs after you configure your SMART-2DH Controller. Interchanging the SCSI IDs will result in loss of data.

Q. I am planning to install several 2.1, 4.3, and 9.1 Gigabyte Fast-SCSI-2 Hard Drives in my Compaq servers. Can I install one of these drives in any drive bay?

A. In the ProLiant and ProSignia Servers you may install these drives in any drive bay; they do not need to be installed in contiguous bays. In Systempro/XL Servers the 2.1, 4.3, and 9.1 Gigabyte Fast-SCSI-2 Hard Drives must only be placed in the four bays in the upper row.

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Q. I ordered my server with a pre-installed SMART-2DH Controller. Will the server ship with the SCSI cable that I will need to connect to my Compaq ProLiant Storage System?

A. No, you will not receive the external SCSI cable with your server. However, the required cable is supplied with Compaq ProLiant Storage systems.

Q. I do not have any hard drives in my server, but I am connecting it to a Compaq ProLiant Storage System which has several hard drives. Which SCSI port do I use?

A. If you have *no* hard drives installed in your server, you can connect the Compaq ProLiant Storage System to either port.

CAUTION: Do not interchange these connectors after you configure your SMART-2DH Controller. Interchanging the connectors could result in a loss of your data.

If you *have* hard drives installed in your server and connected to the SMART-2DH Controller, only one port (2) will be available externally.

Q. I want to connect two Compaq ProLiant Storage Systems to my server. Can I also connect the internal hard drives in my server to the SMART-2 DH Controller?

A. No; if you connect two ProLiant Storage Systems to your server you *cannot* connect any internal hard drives in your server to your SMART-2DH Controller because both SCSI ports will be used externally. You can add an additional SMART-2DH Controller to your server to control any internal drives.

Q. What must I do with System ROMPaq?

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A. You should use System ROMPaq to upgrade the firmware in your server to the latest revisions prior to installing a SMART-2DH Controller in an existing system.

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Q. What must I do if I do not understand the POST error message referring to the SMART-2DH Controller?

A. First, copy down the POST error message for later reference. Refer to Appendix H , "POST Error Messages," for information on each POST error message. If you still do not know what to do, run the Drive Array Advanced Diagnostics utility.

Q. Can I use third-party (not Compaq) drives on the SMART-2DH Controller?

A. Although you *can* use third-party drives, experience in Compaq testing laboratories reveals that you might have problems such as time-outs, data corruption, and so on. The SMART-2DH Controller takes full advantage of SCSI-2 tagged-command queuing, something that can be a problem in the firmware of many third-party drives. Also, Compaq drives feature a unique Pre-failure Warranty. Contact your dealer for more information on Compaq Pre-failure Warranty.

Q. Why do the drive activity lights light up on some drives when my system is idle?

A. The SMART-2DH Controller performs several different background activities on the drives when the controller is otherwise idle. For example, the Auto Reliability Monitoring task scans fault-tolerant volumes for defects and verifies the consistency of parity data. The Drive Parameter Tracking task periodically checks the performance of all drives on the controller, normally on an
hourly basis.

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